Oak Street
UNCLASSIFIED

LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

Univ. of Ill. Library

53
2007

175

THE WEST RIDING OF YORKSHIRE
RIVERS BOARD

REPORT

upon

CHEMICAL AND BIOLOGICAL SURVEY

of

THE RIVER HOLME

J. H. GARNER
F. M. BROWN
M. LOVETT

Wakefield
October, 1936.

THE WEST RIDING OF YORKSHIRE
RIVERS BOARD

REPORT

upon

CHEMICAL AND BIOLOGICAL SURVEY

of

THE RIVER HOLME

Wakefield
October, 1936.

J. H. GARNER
F. M. BROWN
M. LOVETT

Digitized by the Internet Archive
in 2025 with funding from
University of Illinois Urbana-Champaign Alternates

https://archive.org/details/reportuponchemic00west

CHEMICAL AND BIOLOGICAL SURVEY OF THE RIVER HOLME

Introduction

During the period from June, 1926, to November, 1927, a chemical and biological survey of the River Wharfe was made by the laboratory staff of the West Riding of Yorkshire Rivers Board and the research section of the Yorkshire Naturalists' Union acting in collaboration. The results of this survey were published in the Journal of Ecology, Vol. XVIII., pages 273-305 (1930), and reprints were sent to members of the Rivers Board at that time. The River Wharfe is a clean stream, capable of supporting fish life throughout its length. There are comparatively few towns and manufactories situated on its banks, and the sewage and trade effluents discharged to the river are usually of a satisfactory degree of purification.

The published report of the River Wharfe survey attracted the attention of Miss F. M. Brown, Lecturer in Biology at the Huddersfield Technical College, who suggested that useful information might be obtained from a similar survey of a stream flowing through an industrial area, where the amount of pollution might be expected to produce some change in the flora and fauna of the stream. The River Holme, which is unpolluted in its highest reaches, but then passes through a wool-textile manufacturing district, was selected as being a typical and convenient case for investigation.

Following a request for information relating to the various effluents discharged to the stream and the purification processes employed, the Rivers Board arranged for their laboratory staff to undertake chemical and bacteriological examinations in conjunction with the biological investigations which Miss Brown had planned to make.

It was originally intended that the investigations should cover a period of one year, commencing in March, 1933, but it was later decided to continue them for a further period on account of the abnormal droughts experienced during the year. Monthly surveys of the stream were therefore made from March, 1933, until July, 1934.

979366

The River Holme

The River Holme rises in Bleakmires Moss in the Holme Urban District, very near to the Cheshire boundary. In its course the main stream forms the boundary between the Urban Districts of Holme and Holmfirth, flows through the Holmfirth district, and for a short distance divides the Urban Districts of Thurstonland and Farnley Tyas and Honley. The river continues through the Honley district, then forms the boundary between the Urban District of South Crosland and the County Borough of Huddersfield, and finally joins the River Colne near the centre of Huddersfield town.

The river drains the whole of the Urban Districts of Holme, Holmfirth and Honley; nearly all those of New Mill, Meltham and South Crosland; and small parts of Thurstonland and Farnley Tyas Urban District and Huddersfield County Borough. The valley of the River Holme lies between those of the River Colne on the west and the Roundwook Beck on the east; on the south, it adjoins the valley of the River Don. The catchment area is about $37\frac{1}{2}$ square miles, and is shown in the map (Fig. 1) reproduced on page 3.

The River Holme has its source in the millstone grits of the Pennine Chain (see photograph of relief map, Fig 2, page 4), but on the east side of the valley there is a considerable area of the lower coal measures. Consequently, numerous drifts have been made and coal worked, but very few of these workings now remain in use.

The total length of the river is 12 miles. The main tributaries have a total length of about 33 miles, including Digley Brook ($3\frac{1}{2}$ miles), River Ribble (3 miles), New Mill Dyke (4 miles), and Mag Brook ($5\frac{1}{2}$ miles). The highest point of the watershed is 1,908 feet above sea level at Black Hill, on the Cheshire county boundary. The confluence of the Rivers Holme and Colne at Huddersfield is 225 feet above sea level.

Reservoirs and Gathering Grounds

The main stream and its tributaries are all unpolluted near their sources, and have been reservoired as supplies of water for either domestic or trade purposes.

By an Act of 1837, " Commissioners of the Holme Reservoirs " were empowered to make eight reservoirs in the

BASED UPON THE ORDNANCE SURVEY MAP, WITH THE SANCTION OF THE CONTROLLER OF H.M. STATIONERY OFFICE.

Printed by Electric Printing Works Ltd., Leeds.

Fig. 1.—MAP OF RIVER HOLME CATCHMENT AREA.

CHEMICAL AND BIOLOGICAL SURVEY OF RIVER HOLME, 1933-1934.

Reference, Sampling points—

○ River Water Samples.

1 Holme below Brownhill Reservoir.
1A Digley Brook, near its junction with Holme.
3 Holme at Hollin Brigg Lane.
7 Bottom sediment above Perseverance Mill.
8 Holme at Perseverance Mill.
9 Bottom sediment below Perseverance Mill.
12 Holme above Lower Mill.
13 Holme and bottom sediment at Mytholm Bridge.

□ Trade Effluent Samples.

2 Effluent from Holmbridge Mill.
4 Effluent from Yew Tree Mill.
5 Effluent from Hinchcliffe Mill.
6 Effluent from Bottoms Mill.
10 Effluent from Perseverance Mill.
11 Effluent from Valley Dyeworks.

LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

REFERENCE
Streams and Reservoirs shown in white.
County Boundary shown thus
Roads shown thus

SCALE
2 Miles to 1 Inch.

Fig 2.—PHOTOGRAPH OF RELIEF MAP SHOWING RIVER HOLME AND SURROUNDING DISTRICTS.

Holme catchment area, three only of which have been constructed, Bilberry Reservoir on Digley Brook, Holme Styes on the River Ribble and Boshaw Whams at the head of the New Mill Dyke, with gathering grounds of 1,989, 569, and 191 acres respectively. The available capacities of the first two reservoirs are about 73 million gallons each, and the capacity of the last is about 60 million gallons. The Commissioners have entire management and regulation of sluices, so as best to insure at all times, by day and night, a constant and regular supply of water in the several streams for the use of mills and other premises, the night flow to be always at least one-half of that allowed to flow during the day. Further powers were obtained by an Act of 1853 vesting the property of the Commissioners in "The Directors of the Holme Reservoirs" and enabling them to restore and repair their reservoirs, the Bilberry Reservoir having burst its banks in 1852 and caused great damage and the loss of many lives. There is no obligation to discharge compensation water from any of these reservoirs.

The upper part of the main valley of the River Holme has been secured for the water supply of Batley, by Acts of Parliament of 1871, 1878, and 1921. Under the two earlier Acts, three storage reservoirs were constructed—Yateholme, with a gathering ground of 322 acres, an area of 16 acres and a storage capacity of 90 million gallons; Riding Wood, with a gathering ground of 583 acres, an area of 10 acres and a storage capacity of about 51 million gallons; and Ramsden, with a gathering ground of 692 acres, an area of 12 acres and a storage capacity of 86 million gallons. The compensation water discharged from Yateholme was 50.5 cubic feet per minute, from Riding Wood 91 cubic feet per minute, and from Ramsden 250 cubic feet per minute, in each case during twelve hours of each of the five working days and during seven hours on Saturdays. No discharge was provided for Sundays, Christmas Day and Good Friday, and by night. The compensation water discharged from the two higher reservoirs passed into the Ramsden Reservoir, so that the volume discharged from this formed the total amount which reached the River Rolme. It was 1,125,000 gallons on each of the five working days of the week and 656,250 gallons on Saturdays.

By the Act of 1921, the Batley Corporation obtained powers to construct a fourth reservoir (the Brownhill Reservoir) lower down the River Holme, and to impound the waters of the river and its tributaries, except the Rake Dike. The total area of gathering grounds was increased

by only 38 acres, but an additional storage capacity of 266 million gallons was provided. At the same time, alterations were made respecting the discharge of compensation water. The arrangements now in force are that all compensation water is discharged from Brownhill Reservoir, at a point near the northern foot of the dam. Not less than 1,166,000 gallons are to be discharged in a regular uniform and continuous flow during twelve hours of each working day except Saturday and during seven hours of each Saturday, commencing in each case at five o'clock in the morning. Working day means every day in the year except Sundays, Good Friday, Easter Monday, Whit Monday, Christmas Day and Boxing Day. The volume to be discharged during the seven hours on Saturdays is 680,000 gallons. The Act also provides for the erection of gauges open to the inspection of the millowners down to the River Colne, and to all other persons interested therein. Provision is further made for the appointment in every year of a "Millowners' Committee" of seven millowners, who may *inter alia* regulate the hours of each working-day during which the prescribed volumes of compensation water shall be discharged by the Corporation. It will be evident, therefore, that the flow of the River Holme is to a great extent artificially regulated, and during periods of drought the conditions are not at all natural. Further, it should be pointed out that the period covered by the survey included some prolonged droughts and many spells of dry weather, so that the dilution afforded to the various effluents discharged to the stream must have been the minimum likely to be experienced. These factors should be kept in mind when considering the chemical and biological results which were obtained.

In dry weather the waters of the River Holme in its highest reaches consist of the natural water of the Rake Dike, the compensation water from Brownhill Reservoir, and the discharge from Bilberry Reservoir into the Digley Brook. It has not been possible to obtain any particulars respecting the last, but it may be stated that the volume was small in comparison with the other two and that it was too small to exercise any appreciable dilution effect on most of the days when investigations were made. It has, however, been possible to obtain information regarding the flow of the Rake Dike and the volumes of compensation water from Brownhill Reservoir, as these are measured and recorded by the Batley Waterworks Department. Fig. 3 shows the separate and combined rates of flow in the Rake Dike and of the compensation water at the gauge just below Brownhill Reservoir, at the times the monthly surveys were made. It has been

thought advisable to express the rates of flow in "thousand gallons per hour," because, while the Rake Dike is by-passed round the reservoir and flows continuously under natural conditions, the compensation water is discharged at the prescribed rates and times previously mentioned.

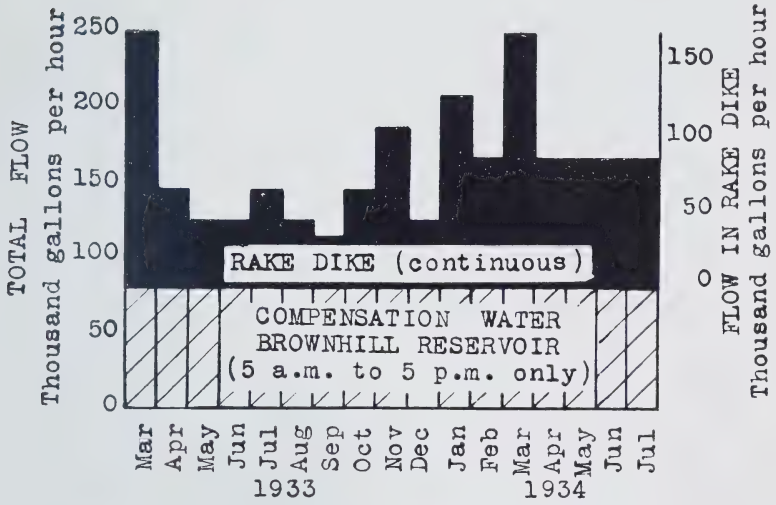

Fig 3.—Separate and Combined Rates of Flow below Brownhill Reservoir.

Rainfall

Particulars of rainfall on the reservoired catchment areas of the upper River Holme and Digley Brook are given in the table on page 8. Over the whole period of the survey, the total rainfall was only about two-thirds the average amount for the same period, as computed from statistics published in "British Rainfall." From column (1) of the table, it will be observed that on only five occasions was there more than 0.1 inch of rain during the 48 hours preceding the times at which surveys were made and samples taken.

Rainfall—River Holme Catchment Area

Date of Survey	(1) * River Holme Preceding 48 hours	(2) * River Holme Total for month	(3) † Digley Brook Total for month
1933			
23rd March	nil	3.97	2.50
27th April	0.79	2.11	2.00
18th May	0.05	2.14	2.20
15th June	0.07	4.17	2.96
20th July	0.05	5.50	3.10
10th August	0.06	1.26	0.94
21st September	0.04	2.84	2.50
19th October	nil	6.95	5.61
21st November	0.05	3.15	2.25
14th December	0.07	1.06	0.80
1934			
16th January	1.58	6.30	4.33
20th February	0.01	0.36	0.27
20th March	0.76	5.55	4.25
24th April	0.63	3.88	3.75
15th May	0.39	4.73	4.04
— June	(No sampling)	2.62	2.20
10th July	nil	4.09	2.75

* Average of four stations (Batley Waterworks Department).
† Bilberry Reservoir (Directors of the Holme Reservoirs).

The particulars of total monthly rainfalls given in column (2) of the table are shown graphically in Fig. 4.

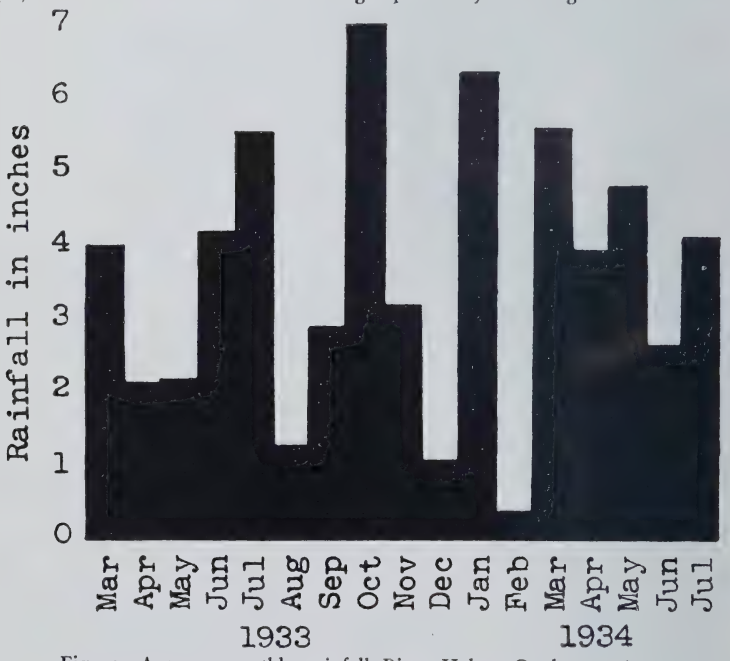

Fig. 4—Average monthly rainfall River Holme Catchment Area.

Preliminary Survey

As the result of a preliminary survey of the river, it was decided to restrict investigations to the reach commencing near Brownhill Reservoir and terminating at Mytholm Bridge. This reach, shown in Fig. 5, is about $4\frac{1}{2}$ miles long. The banks are flat for the most part, and the depth and flow of the stream are such as to facilitate the study of bottom deposits. There is little pollution of this part of the river by domestic sewage, as nearly all the inhabited districts are connected to the Holmfirth sewerage system which conveys the sewage to satisfactory purification works situated about one mile downstream from Mytholm Bridge Only in wet weather, when stormwater overflows come into operation, does any appreciable amount of sewage reach that part of the river covered by this survey. Between Brownhill Reservoir and Lower Mill there are six manufactories engaged in the wool-textile and dyeing industries from which treated effluents are discharged to the river. Each of these manufactories has its own treatment plant, generally consisting of precipitation tanks and straining filters, for the removal of grease and suspended solids, but, as is usual in such cases, no attempt is made to give subsequent biological purification.

Pollution, therefore is mainly due to trade effluents and, during the preliminary survey, observations were made to ascertain the effect of these effluents on the flora and fauna of the stream. It was apparent that only the short length of river between Brownhill Reservoir and Holmbridge (see Fig. 5) supported stream-life characteristic of clean water. A short distance below the effluent outfall from the first mill, it was observed that nearly all plant organisms had disappeared and only a few species of animalcula persisted, although the mill effluent contained only small amounts of suspended solids and nitrogenous matter and had a low biochemical oxygen demand.

In view of the rather marked change of conditions, it was decided to make and compare numerical analyses of a series of biological collections taken (a) from the clean upper stream just below Brownhill Reservoir (sampling point No. 1), and (b) from the river a short distance below the effluent outfall of the fifth mill downstream (Perseverance Mill; sampling point No. 9), with the object of showing quantitatively the effects of pollution on the fauna. A further examination was made lower downstream, at Mytholm

Bridge (sampling point No. 13). As the biological collections at this point were similar to those obtained near Perseverance Mill, no numerical analyses were considered necessary, although as a check the various species present were recorded.

At all three collecting stations the banks and bed of the stream are similar, the latter consisting of stones and pebbles of various sizes resting on sandy mud. Nowhere along the stream are there any large rooted water-plants, as the current is generally too swift to permit their growth.

Sampling Points

In connection with the main survey, a number of suitable and convenient points were selected along the stream, with the object of tracing step by step the effects of the various pollutions. Samples of stream water were taken at six points (Fig. 5, Nos. 1, 1a, 3, 8, 12 and 13), the oxygen in solution being determined at the time of sampling. Samples of trade effluents discharging into the river were taken at the six manufactories (Fig. 5, Nos. 2, 4, 5, 6, 10 and 11), and samples of bottom deposits from the stream were taken at three points (Fig. 5, Nos. 7, 9 and 13). The biological collections were made at the three points previously mentioned (Fig. 5, Nos. 1, 9 and 13).

The water used in the manufacturing processes is taken either from the River Holme or from small tributary streams.

Methods Used in the Chemical Analysis of Streamwaters and Trade Effluents

To assist in the interpretation of the chemical analyses given later, it is thought desirable to describe briefly the methods and procedure adopted.

(1) Total Solids. This figure is the sum of the solids in suspension and the solids in solution.

(2) Solids in suspension. The sample was thoroughly shaken and 250 to 500 c.c. (according to the amount of sediment) were passed through a Munktell's No. 1F. filter paper, which had been previously fluted and dried to constant

Fig. 5—MAP OF RIVER HOLME SHOWING

CHEMICAL AND BIOLOGICAL SURVEY OF RIVER HOLME, 1933-1934.

Reference, Sampling points—

○ River Water Samples.

1 Holme below Brownhill Reservoir.
1A Digley Brook, near its junction with Holme.
3 Holme at Hollin Brigg Lane.
7 Bottom sediment above Perseverance Mill.
8 Holme at Perseverance Mill.
9 Bottom sediment below Perseverance Mill.
12 Holme above Lower Mill.
13 Holme and bottom sediment at Mytholm Bridge.

□ Trade Effluent Samples.

2 Effluent from Holmbridge Mill.
4 Effluent from Yew Tree Mills.
5 Effluent from Hinchliffe Mill.
6 Effluent from Bottoms Mill.
10 Effluent from Perseverance Mill.
11 Effluent from Valley Dyeworks.

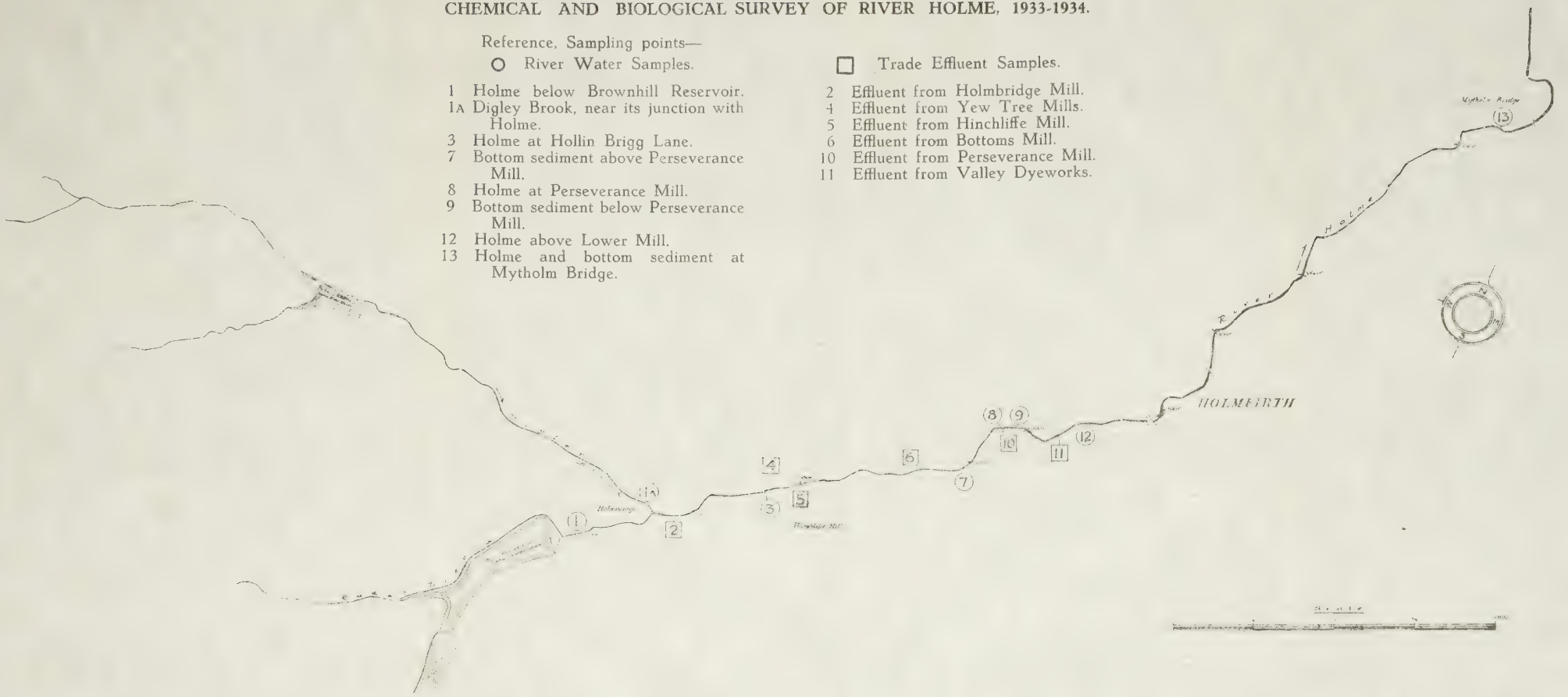

Fig. 5—MAP OF RIVER HOLME SHOWING SAMPLING POINTS.

weight at 100° C., in a glass stoppered weighing tube placed in a steam oven. The filter paper with the solids was next washed with distilled water and again dried until constant in weight, the increase in weight being the amount of solids in suspension in the volume of sample taken.

(3) Solids in suspension—Ash. In determining the ash (mineral matter) of the suspended solids, the filter paper and solids were transferred to a weighed platinum capsule and ignited at red heat to constant weight, allowance being made for the weight of ash of the filter paper.

(4) Solids in solution. A suitable volume (generally 100 c.c.) of the filtrate from (2) was placed in a tared platinum dish, evaporated to dryness on a water-bath, and finally dried to constant weight at 100° C., in a steam oven, the increase in weight being the amount of solids in solution.

(5) Solids in solution—Ash. The ash (mineral matter) of the solids in solution was determined by heating the platinum dish and contents to a dull red heat and subsequently weighing, undue prolongation of the ignition being avoided.

(6) Chlorides. In accordance with the practice in the Rivers Board laboratory, chlorides have been expressed in terms of sodium chloride in the tabulated analyses contained in this report. The chlorides were estimated by titrating 100 c.c. of sample with a standard solution of silver nitrate (1 c.c.=0.005 gram. NaCl), using potassium chromate as indicator. Before titration, excessively alkaline samples of trade effluents were neutralised with dilute nitric acid.

(7) Nitrogen, from free and saline ammonia. A suitable volume of sample (250 c.c. or less) was distilled from a round-bottomed flask of $1\frac{1}{2}$ litres capacity, fitted with splash-head and totally enclosed metal Cribb condenser, and containing about 1 litre of ammonia-free distilled water made slightly alkaline by the addition of 1 c.c. of 10 per cent. sodium carbonate solution. The distillate was collected, either in a 250 c.c. graduated flask or in 100 c.c. Nessler tubes, until the final portion was ammonia-free. The amount of ammonia was then estimated by adding 2 c.c. of Nessler solution to an aliquot part of the 250 c.c. in a Nessler tube or to each tube of distillate, and matching the colour produced with that of standards prepared by nesslerising solutions containing known amounts

of ammonium chloride (1 c.c.=0.00001 gram. of nitrogen). This method of estimating ammonia is so delicate that by its aid, using 1 litre of sample, one part can be detected and estimated in a hundred million parts of the water.

(8) Albuminoid nitrogen. The method used in this determination was that devised by Wanklyn (Journal of the Chemical Society, Vol. 20, page 445). To the liquid remaining in the flask after the free and saline ammonia had been distilled off, 25 c.c. of an alkaline solution of potassium permanganate (containing 8 grams potassium permanganate and 150 grams caustic soda per litre) were added and the distillation continued until no ammonia was present in the last portion of distillate. The ammonia in the distillate was estimated with Nessler reagent as described under (7). Generally, five 100 c.c. tubes of distillate were collected for this determination.

(9) Organic nitrogen. The organic nitrogen is the difference between the total nitrogen as determined by the Kjeldahl process (Zeitschr. Anal. Chemie, Vol. 22, p. 366) and the ammoniacal nitrogen. A suitable volume of sample (250 c.c. or less) was heated with 10 c.c. of concentrated nitrogen-free sulphuric acid until the organic matter was destroyed and the remaining liquid clear, the nitrogen of organic bodies being thus converted into ammonium sulphate. The liquid, after cooling, was diluted by adding about 500 c.c. of ammonia-free water, made slightly alkaline with caustic soda solution and distilled from a round-bottomed flask, the distillate being collected in a 250 c.c. graduated flask as under (7). An aliquot portion of the distillate was nesslerised as previously described.

(10) Nitric nitrogen. The method adopted was the Sprengel or phenol-sulphonic acid process (Grandval and Lajoux, Comptes rendus, 6th July, 1885). Of the sample 25 c.c. were evaporated to dryness in a porcelain dish on the water bath, 2 c.c. of phenoldisulphonic acid reagent were added, care being taken to ensure that the whole of the residue in the dish was brought into contact with the acid, and the heating on the water bath continued for a few minutes. The contents of the dish were then diluted, made alkaline with caustic soda solution, and the resulting yellow colour matched against standards similarly prepared from potassium nitrate solution (1 c.c.=0,00001 gram nitrogen).

West Riding of Yorkshire Rivers Board.

With the Chief Inspector's
Compliments.

71 Northgate.
Wakefield.

(11) Oxygen absorbed from N/80 permanganate in four hours at 80° F. The estimation was performed as follows :— Into a 12oz. stoppered bottle were placed 150 c.c. of distilled water and 10 c.c. of dilute sulphuric acid (prepared by mixing one volume of concentrated acid with three volumes of distilled water and tinting the mixture with potassium permanganate, to destroy organic matter). After bringing the contents of the bottle to 80° F., a suitable volume of sample (50 c.c or less) and 10 c.c. of N/80 permanganate solution were added, and the mixture incubated at 80° F., for four hours. An excess of at least 5 c.c. of permanganate was maintained by adding further 10 c.c. portions of permanganate during the four hours, if necessary. At the end of the period, 2 c.c. of 5 per cent. potassium iodide solution were added and the liberated iodine titrated with N/80 sodium thiosulphate solution, using starch solution as indicator. This gives the amount of thiosulphate solution corresponding to the unused permanganate, and the amount of permanganate used in the oxidation reaction can be ascertained by difference. Blank tests were carried out on the reagents and the appropriate correction applied in the determination.

(12) Alkalinity. Of the sample, 100 c.c. were titrated in a porcelain basin with decinormal hydrochloric acid, using methyl orange as indicator. Caustic alkalinity, when present, was determined by a similar titration using phenolphthalein as indicator. For convenience in comparison most of the results have been expressed in terms of calcium carbonate.

(13) Oxygen in solution (at time of sampling). Samples for this determination were taken at middle depth of stream in 380 c.c. bottles placed in a specially-designed collecting vessel consisting of a brass cylinder with a tightly-clamped cover plate through which a tube reaches to the bottom of the sample bottle. The first water entering the bottle overflowed into the collector, there being several displacements of the contents of the bottle before the sample was finally obtained without its coming into contact with the atmosphere. The oxygen in solution was determined at the time of sampling, using a field-set, by the Rideal-Walker modification of the Winkler method (Analyst, Vol. 26, p. 141, 1901). The temperature of the water was noted, and the percentage saturation of dissolved oxygen calculated from the table

given in "Standard Methods for the Examination of Water and Sewage" (American Public Health Association, 7th Ed., 1933).

(14) Dissolved oxygen absorbed in five days at 65° F. (Biochemical Oxygen Demand). In this determination the sample was incubated (after suitable dilution with well-aerated tap-water of good quality) in bottles of known capacity, having specially ground-in glass stoppers, in a Hearson's electrically-controlled incubator. The initial and residual amounts of oxygen in solution were determined by the method used in (13), which was used by the chemists of the last Royal Commission on Sewage Disposal (Fourth Report, Vol. IV., Part V., 1904; and "Methods of Chemical Analysis as applied to Sewage and Sewage Effluents," H.M. Stationery Office, 1929). The figures given in the tables are the average results of duplicate determinations.

The tests for oxygen in solution (13) and five-day biochemical oxygen demand (14) are of great value in a study of the effect of pollution on a stream. The former is a measure of the amount of oxygen available for the normal biological functions of the stream, and the latter a measure of the pollution load. The so-called "oxygen balance" is the algebraic difference between the two values, and provides a useful measure of the ability of the stream to cope with the pollution under conditions then obtaining.

Considered broadly, at the present time, so long as the oxygen balance remains positive, conditions may be regarded as satisfactory from a chemical point of view. If the oxygen balance becomes negative the stream is probably receiving excessive pollution, and in the absence of other factors, such as subsequent re-aeration, conditions of chemical and biological instability may be set up.

(15) Transparency (in inches). The transparency values given in the tables refer to the depth of sample which was just necessary to obscure black cross lines marked in 2mm. squares on a white porcelain disc at the bottom of a glass tube 2ft. high and $1\frac{1}{2}$in. diameter. (Reid, Proc. Roy. Soc. B., Vol. 79, p. 63, 1907).

(16) Presumptive B. coli. As a matter of additional interest counts of presumptive B. coli per c.c. were made on the samples of stream water, the methods employed being similar to those described in "The Bacteriological Examination of

Water Supplies" (1934), H.M. Stationery Office. The figures are given in the last column of the tabulated analytical results.

Biological Methods

At each sampling station a length of about 50ft. of stream was examined. For the collection of samples, an aluminium frame 25cm. square was placed on the bed of the stream, and a plankton net having its opening in a vertical position arranged on the downstream side of the frame. The stones within the frame were then examined, and their covering of moss or slime was brushed off into the net.

Numerical analyses of the samples were made in the biological laboratory of the Huddersfield Technical College, usually within a few hours of collection. On the few occasions when counting was delayed, a few c.cs. of 2 per cent. formaldehyde solution were added to the material. This was found to be a satisfactory preservative for both plant and animal species.

No attempt was made to collect systematically the species living freely in the stream, since the variation in rate of flow made this impracticable.

Classification of River Samples

The classification of river samples is that suggested by the Royal Commission on Sewage Disposal (Eighth Report, Vol. 1, p. 5). After investigating a number of typical streams of various degrees of impurity, and making many analyses and observations of the conditions, the Commission found it possible to adopt an approximate classification based on the determination of the amount of dissolved oxygen absorbed in five days at 65° F. The period of five days was taken as representing the least time in which effluents discharged into the majority of English rivers could reach the sea, and 65° F. was adopted as being the average summer temperature of stream waters.

This classification, according to the dissolved oxygen absorbed in five days at 65° F., is as follows :—

Very Clean	...	Absorption	0.1	parts per	100,000
Clean ...	...	,,	0.2	,, ,,	,,
Fairly clean	...	,,	0.3	,, ,,	,,
Doubtful ...	...	,,	0.5	,, ,,	,,
Bad ...	...	,,	1.0	,, ,,	,,

Classification of Trade Effluents

The waste liquids from the six manufactories discharging to that portion of the stream under investigation are derived either from piece-scouring and dyeing or from piece-scouring alone. With regard to standards for effluents of these types, the suggestions of the Royal Commission on Sewage Disposal (Final Report, p. 15, 1915) may be quoted, *viz.*:—

"*Cotton Dyeing.*

"Compared with many other wastes, these are not "very polluting, but their volume is large. Although "most of their oxygen absorbing power is due to "dissolved impurities, considerable improvement is "effected by clarification.

"We suggest as a standard 4 parts suspended "solids per 100,000."

"*Woollen Dyeing, Piece and Yarn Scouring and Blanket "Scouring Liquors (occurring either separately or in any "combination).*

"Though these wastes are not usually concentrated, "their liquid portion is, as a rule, of an oxygen "absorbing and putrescent nature. Clarification produces "considerable improvement. As a standard we suggest "4 parts suspended solids per 100,000."

The Rivers Board had previously adopted the same standard, samples containing more than 4 parts of suspended matter per 100,000 being classed "unsatisfactory as regards suspended solids."

Sampling Points and General Conditions

To facilitate reference, the sampling points are described in order of sequence down stream.

No. 1—Immediately below Brownhill Reservoir.
(Sample of stream water and biological collection.)

As previously stated, the stream water at this point is composed partly of compensation water from Brownhill Reservoir and partly of the normal discharge from Rake Dike. Any overflow from the reservoir passes to the main stream down a spillway shown on the right in Fig. 6. This has a total length of approximately 600 feet, the gradient of the central portion being 1 in 4 in the lower part and 1 in 3 in the upper part. The water from Rake Dike, which is

permanently by-passed along a specially constructed concrete channel on one side of the reservoir, also passes down this spillway. In consequence of the steep gradient, any water passing down it receives considerable aeration, and, as would be expected, the oxygen in solution at this sampling point was always high.

The Rake Dike receives surface water from Holme Village and from the road over Holme Moss. The drainage from about 40 houses in this district is irrigated over four acres of land on the left bank of the stream, but is almost entirely absorbed. The Dike is therefore not normally subject to any pollution.

The amount of water brought into the Holme by this stream varies from a trickle in dry weather (drought of August and September, 1933) to a rapid current after heavy rain. At such times there is usually a very heavy peaty suspension in the water draining from the moors and this naturally has an immediate effect on the quality of the main stream (see analytical data, Second Survey, page 48).

At the point of sampling, the stream is 20ft. wide and has an average depth of about 8ins. As previously mentioned, the bed of the stream consists of stones up to 2ft. in diameter, resting on sandy mud. The stones are partially covered with a growth of mosses, chiefly *Hypnum ochraceum*, *Fontinalis* spp., and where the tops of the stones stand above the water level there are clumps of grasses and meadow plants. A small growth of *Batrachospermum* attached to the submerged stones is fairly constant, and there are occasional heavy growths of *Vaucheria, Ulothrix* and *Spirogyra*. These latter are not permanent. After heavy rain, the algal growth may be almost entirely carried away in the swift stream, as happened in October, 1933.

During the whole of the period covered by this investigation the conditions at this point were those of a "very clean" stream, according to the Royal Commission classification. The dissolved oxygen absorbed in five days (B.O.D.) was never in excess of 0.10 parts per 100,000 and was generally well below that figure. The percentage oxygen saturation was usually over 80, and there was always a very large positive oxygen balance. Usually there was only a trace of suspended matter present, and dissolved solids, nitrogen values and bacterial count were very low.

Fig. 6—River Holme immediately below Brownhill Reservoir showing discharge of Compensation Water and Confluence with Rake Dike (right).

The figures for the oxygen in solution and dissolved oxygen absorption determinations are shown graphically in Fig. 7. In this, as in the graphs relating to other sampling points on the stream, the oxygen in solution is shown above the zero horizontal and the dissolved oxygen absorption below. The "oxygen balance" is therefore shown above the zero line when positive, and below it, when negative. The oxygen saturation values corresponding to the temperature of the stream at the time of sampling are also shown for comparison.

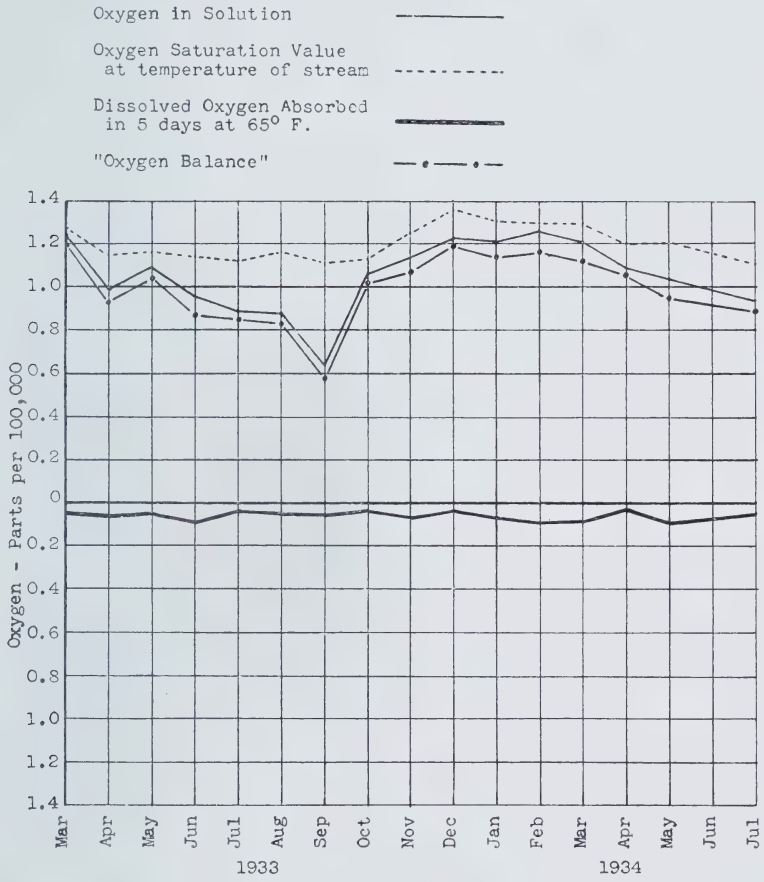

Fig. 7.—Comparison of Oxygen Data, Brownhill Reservoir.

The fauna is characteristic of a clear and fairly swift stream. Attached to the under and downstream surfaces of the stones were found numerous Caddis, *Simulium*, Mayfly

and *Perla* larvae, *Ancylus* and *Limnae*. A few *Gammarus* were present near the banks in the quieter part of the stream.

Associated with the mosses were larvae of *Dicranota*, Mayfly and *Tanypus*, waterbeetles, *Pisidium* and *Hydra*. *Hydracarina* were numerous in the crevices of the stones, and occasionally small colonies of the Polyzoan *Plumatella* were found The occasional heavy growths of algae had numerous diatoms and protozoa associated with them—*Vorticella*, *Arcella*, *Diflugia* and *Gonium* being particularly numerous. No attempt was made, however, to keep a complete record of microscopic organisms. A tabulated faunistic list is given on page 46.

Trout have been introduced into Brownhill Reservoir, and occasionally small fish have been seen in the stream as far down as Holmfirth, some $2\frac{1}{4}$ miles below this point.

No. 1a—Digley Brook at Holmbridge

(Sample of stream water.)

Digley Brook is a tributary of the River Holme (left bank), the confluence being just below the sampling point. Above this point the brook receives the drainage from isolated property and also a small amount of seak-tank effluent from Digley Mill. The flow in the brook is never very great, and at the time of five of the monthly visits there was no flow, but the condition of the stream was generally satisfactory and would not normally have any appreciable effect on the condition of the River Holme.

No. 2—Holmbridge Mill

(Sample of trade effluent.)

The waste liquids at this mill are derived from the piece-scouring of fancy worsted goods. The average daily volume of refuse consists of about 16,000 gallons of thick scouring liquid and about 40,000 gallons of washing-off water. The former is treated with alumino-ferric precipitant, settled in two tanks, and then filtered through straining beds composed of graded ashes. The wash-off waters are fairly clean and receive no treatment. The samples taken for analysis were from the treatment of the thick scouring refuse.

The effluent was generally satisfactory as regards suspended solids (containing less than 4 parts per 100,000) and was low in nitrogenous matter and biochemical oxygen demand. The alkalinity expressed in terms of calcium carbonate to methyl orange was generally about 20 parts per 100,000.

No. 3—Hollin Brigg Lane
(Sample of stream water.)

There is no discharge to the river between the last sampling point (Holmbridge Mill) and this one, a distance of about 500 yards. Normally it would be expected, therefore, that any change in the condition of the stream from that just below Brownhill Reservoir is due to the combined

Fig. 8.—River Holme at Hollin Brigg Lane.

effect of the entrance of Digley Brook and the effluent from Holmbridge Mill. On the occasions of the tenth and fifteenth surveys (in December, 1933, and May, 1934, respectively) there was no flow in Digley Brook and no effluent from Holmbridge Mill, and, although the analyses apparently show very slight pollution, there was no marked change in the quality of the stream water.

The general conditions corresponded to "clean" or "fairly clean," and on only one occasion (in September, 1933) was it definitely "bad," when the effluent from Holmbridge Mill was only "fair," and the water in Digley Brook was classified as "doubtful." With this exception, there was always a large positive oxygen balance at this point.

The figures for the oxygen determinations are shown graphically in Fig. 9.

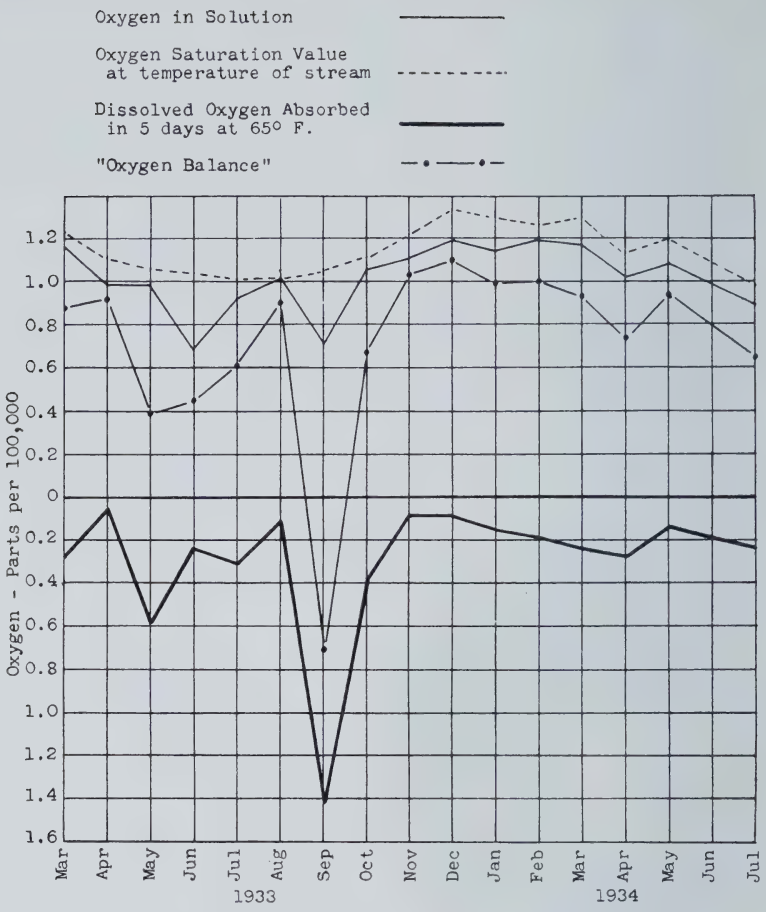

Fig. 9.—Comparison of Oxygen Data, Hollin Brigg Lane.

No. 4—Yew Tree Mills

(Sample of trade effluent.)

The waste waters at this mill are derived from the piece-scouring and dyeing of woollen and worsted goods. The normal daily volume of refuse consists of about 5,000 gallons of scouring and washing-off waters, 4,000 gallons of waste from yarn dyeing, and 4,000 gallons of washing-off water after dyeing. The liquids from scouring and dyeing are mixed in an averaging tank, treated with alumino-ferric precipitant in two settling tanks, and afterwards passed through a straining filter made of graded ashes. The washing-off water from dyeing is almost clear although slightly discoloured and

receives no treatment. The effluent is discharged to Stubbin Clough, just above its confluence with the River Holme. A small volume of sink waste from property adjoining the mill also passes into this tributary. The analyses of samples taken at this point show rather wide variation, and are a good illustration of the changes with which the stream life has to cope. On several occasions the samples of effluent contained an excessive amount of suspended solids and also some caustic alkalinity. The five-days biochemical oxygen demand varied from 0.56 to 11.08 parts per 100,000, and the nitrogen values were particularly high, there being over 1 part per 100,000 from free and saline ammonia on several occasions. The first sample contained 71.8 parts per 100,000 of fatty matter after acidification, indicating that insufficient alumino-ferric had been used for precipitating the refuse.

No. 5—Hinchliffe Mill

(Sample of trade effluent.)

The waste waters at this mill consist mainly of piece-scouring and washing-off refuse from woollen manufacture, but throughout the period of the survey very little trade was being done. Work was generally restricted to one day per week, when the volume of refuse was about 5,000 gallons. All the refuse from scouring and washing-off was precipitated with alumino-ferric in two tanks, and afterwards passed through straining filters. Occasionally a small amount of light coloured dyeing was done, and the spent dyewaters were discharged without any treatment. There was no effluent at the time of surveys 1 to 6 inclusive, 10, 12 and 14. On the remaining occasions the effluent was fairly satisfactory according to the usual standards. The five-days biochemical oxygen demand varied from 0.24 to 2.03, and the figures for other determinations showed no abnormality.

On account of the small volume and infrequent discharge, it may be taken that the effluent from this mill had no appreciable effect on the stream.

No. 6—Bottoms Mill

(Sample of trade effluent.)

The waste waters at this mill come from the processes of piece-scouring and dyeing of light woollen goods. The average daily volume of refuse consists of about 25,000 gallons of thick scouring liquid, 50,000 gallons of washing-off water, and about 30,000 gallons of dyewaters. The thick scouring liquid is pumped for treatment with alumino-ferric

preciptant in a series of three tanks. The effluent from these tanks mixes with the washing-off waters and dyewaters, and the mixture receives further settlement in a series of five tanks. The total volume of refuse is 105,000 gallons per day, and most of this is discharged during a working day of about ten hours. The effluent from the treatment plant was satisfactory according to the usual standards, except on one occasion. At the times of surveys 14 and 15, however, some untreated refuse was being discharged owing to the pump being temporarily out of action. These two discharges contained small amounts of caustic alkalinity, and had a five-days biochemical oxygen demands of just over 2 parts per 10,000.

Sink waste from a few isolated groups of houses, and periodically small discharges of clarified wash-waters from the manufacture of Glauber's Salt at Liphill Chemical Works, reach the river by a small tributary between sampling points 6 and 7.

The volume of trade effluent from Bottoms Mill constituted one-half of the total average daily volume of effluents reaching the river between its source and Lower Mill (Sampling Point No. 12).

No. 7—Weir above Perseverance Mill

(Sample of bottom deposit.)

The bottom deposit consisted mainly of vegetable debris and dyed wool fibres. There was no fibrous deposit on the

Fig. 10—Weir above Perseverance Mill.

bed of the stream above this point. It appeared, therefore, that the presence of dyed wool fibres was due to periodical escapes of untreated refuse from Bottoms Mill direct into the tail goit, which discharges immediately above this weir. Profuse growths of *Sphaerotilus natans* over the whole bed of the stream were frequently observed. Worms, snails, leeches and larvae were usually present, but no pollution organisms were seen on the first and second visits (March and April, 1933). They appeared in May, 1933, and were in evidence throughout the following dry period, during which time green growth was visible on exposed stones. The effect of letting off the dams higher up the river during the local holiday week was shown by the appearance in September, 1933, of an accumulation of about 2ft. of sandy deposit behind the weir. The bottom deposit had a slightly disagreeable odour on occasions, and became septic on keeping in a closed bottle, when a slight ochrey scum developed on the surface. Heavy rain in March, 1934, made investigations impossible owing to the greatly increased flow. Numerous large purplish worms were observed on the following three visits. (See also table on page 43).

Determinations of the oxygen in solution were made at this point at the time of sampling.

No. 10—Perseverance Mill

(Sample of trade effluent.)

The waste waters at this mill consist entirely of piece-scouring refuse and washing-off waters. The total volume is about 11,000 gallons per day. All the refuse is treated with alumino-ferric precipitant and settled in a series of four tanks. The effluent was invariably satisfactory; the five-days biochemical oxygen demand was generally only about 0.4 part per 100,000, and never in excess of 1 part per 100,000. The alkalinity and nitrogen figures were also low.

Nos. 8 and 9—Just below Perseverance Mill

(Sample of stream water and biological examination.)

These points are only about 20 yards apart, the upper being at the bridge to Perseverance Mill. From this, the sample of stream water was taken. The lower one was more suitable for biological examination and the collection of a sample of bottom deposit. The graph in Fig. 12 shows clearly that the condition of the stream was bad during the summer months of 1933. This was probably mainly due to the extreme drought experienced during that period, and corresponds with the appearance of the pollution organisms

Fig. 11.—River Holme below Bridge to Perseverance Mill.

mentioned under No. 7 above. The high biochemical oxygen demand in May, 1933, was due to pollution from a tributary stream below Yew Tree Mills. At the time of the visit the water in this stream was slightly turbid and reddish brown in appearance. With the exception of this period, and an occasion in May, 1934, there was generally an adequate oxygen balance at this point.

The stream is wider in this region, being about 42ft. (as compared with 20ft. at Brownhill). The normal depth of water is about 6ins. The stones have no water plants associated with them, and are covered with a deposit of sludge varying in quantity from time to time. The bottom deposit at the lower point was generally similar to that described under No. 7. (See also table on page 43).

Living in the sludge were large numbers of the oligochaete worm *Nais* and the larvae of *Tanypus*. There were also large numbers of leeches and snails, but these were attached chiefly to the relatively clean under-surfaces of the stones. Planarians, *Hydra fusca* and polyzoan colonies were found occasionally during the summer months.

The numbers of the worms and larvae collected varied with the amount of sludge present. A heavy flow of water sometimes cleared this from the tops of the stones, and the

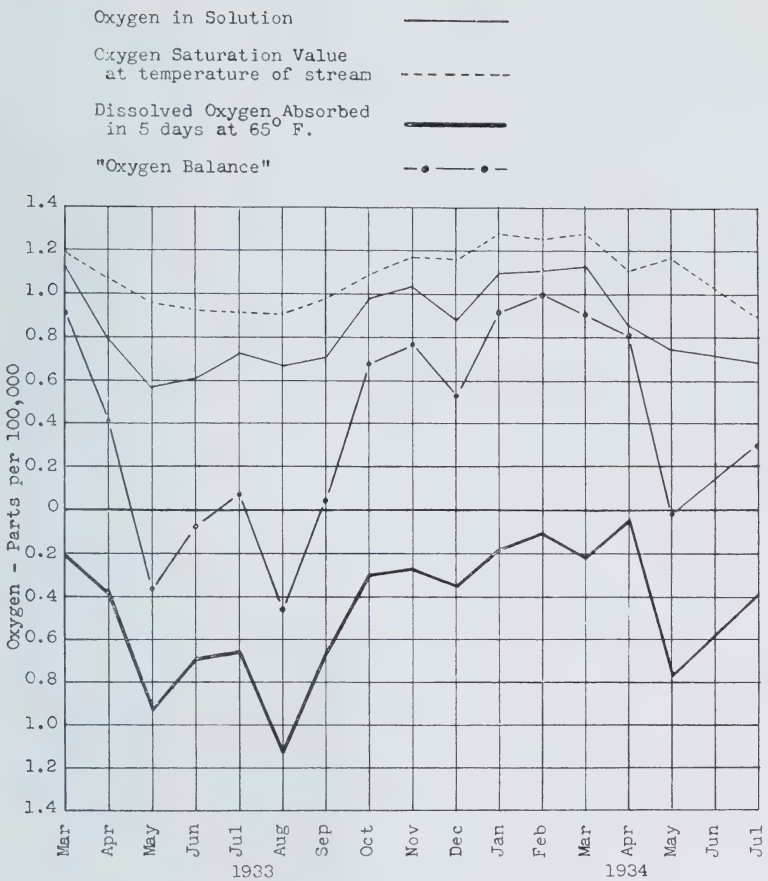

Fig. 12.—Comparison of Oxygen Data, below Perseverance Mills.

animals were then found chiefly on the under and downstream surfaces and appeared to burrow temporarily into the bed of the stream. A tabulated faunistic list is given on page 46).

No. 11—Valley Dyeworks.

(Sample of trade effluent.)

The waste waters at these premises are produced in the dyeing and washing of pieces and yarns for the woollen industry. The average daily volume of refuse is about 20,000 gallons, all of which is treated in a plant consisting of two settling tanks and two straining filters. The quality of the effluent varied somewhat, but was generally satisfactory as

regards the usual standard for suspended solids and had a five-days biochemical demand ranging from 0.1 to 2.2 parts per 100,000.

No. 12—Above Lower Mill.

(Sample of stream water.)

There are no discharges to the river between this point and the previous one. At the times of the first seven

Fig. 13—River Holme above Lower Mill.

surveys the condition of the stream was "bad" according to the Royal Commission classification. On the succeeding occasions it showed some improvement, varying between "clean" and "doubtful." The percentage oxygen saturation was fairly high, but, during the period April to September, 1933, with a single exception, high biochemical oxygen demand gave rise to conditions of negative oxygen balance.

The oxygen data are shown in Fig. 14.

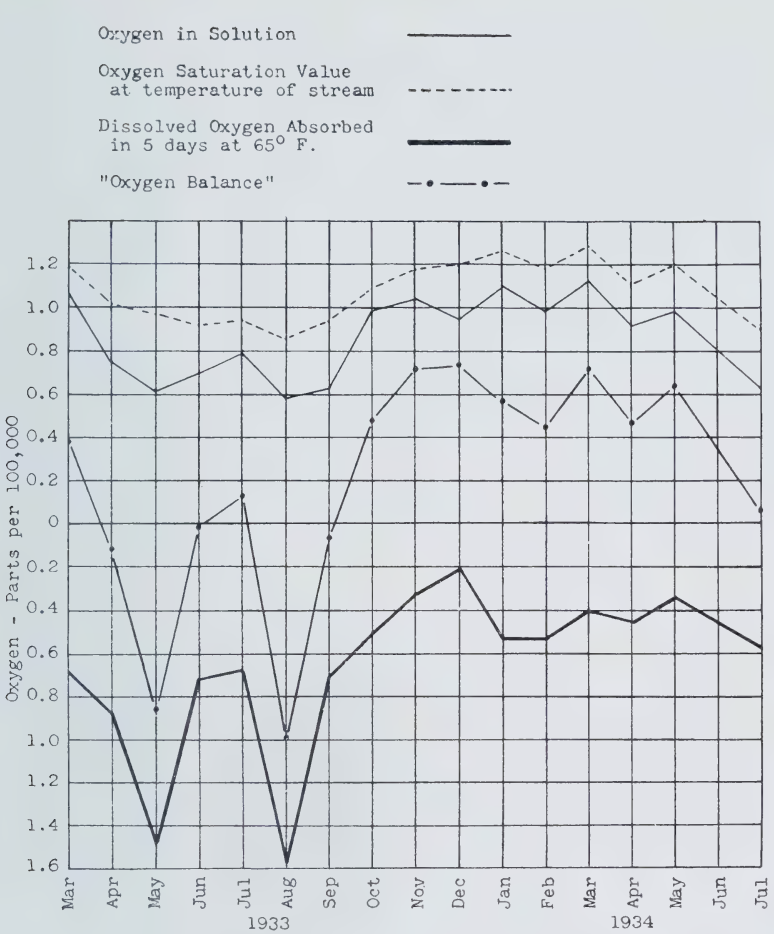

Fig. 14—Comparison of Oxygen Data, below Lower Mill.

No. 13—Above Mytholm Bridge

(Sample of stream water and bottom deposit.)

Between this point and the preceding one, the river receives water from three small tributary streams and effluents from several mills. It was not possible however, to extend the investigation to include the special sampling and analysis of these, although routine inspection and sampling of the mill effluents were made throughout the period of the survey.

During the earlier part of the investigation, the river was generally "bad" according to the Royal Commission classification. Some improvement was maintained after

Fig. 15.—River Holme above Mytholm Bridge.

September, 1933, but even then conditions were never better than "doubtful." The graph (Fig. 16) shows that on only four occasions was there a distinct positive oxygen balance.

The bottom deposit consisted generally of a mass composed mainly of textile fibres and vegetable debris (leaves, straw, etc.). There was usually little or no odour, and fungus growth, though dense on occasions, was usually either slight or else entirely absent.

As previously stated, the fauna was similar to that below Perseverance Mill (Sampling Point No. 9). Further particulars are given in the tabulated list, page 46).

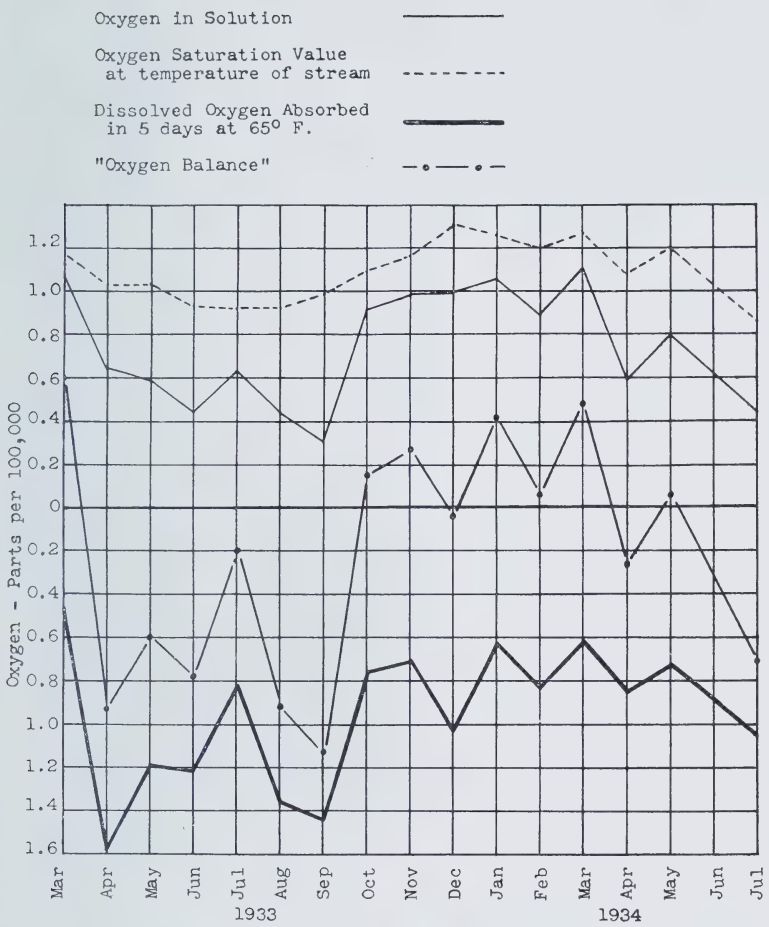

Fig. 16.—Comparison of Oxygen Data above Mytholm Bridge.

FAUNISTIC LIST

This list includes all stages in the life cycle.

† Indicates that specimens have been taken at that point.

CLASSES Orders (Sub-Orders) Species	Below Brownhill Reservoir	Below Perseverance Mill	Above Mytholm Bridge
HYDROZOA			
Hydra fusca	†	†	†
PORIFERA			
Ephydatia fluviatilis ...	†		
POLYZOA			
Plumatella...	†	†	
PLATYHELMINTHES			
Planaria spp.	†	†	†
ANNELIDA			
Oligochaeta			
Nais elinguis	†	†	†
Hirudinea			
Glossosiphonia concolor ...	†	†	†
Glossosiphonia complanata ...	†	†	†
Piscicola geometra	†	†	†
ARTHROPODA			
Crustacea			
Gammarus pulex	†	† (rare)	
Daphnia sp.	†		
Hydracarina			
2 spp.	†		
Insecta			
(Plecoptera)			
Perla bipunctata	†		
(Sialidae)			
Sialis	†		
(Ephemeroptera)			
Baetis binoculatus	†		
(Ecdyurus)			
Ephemerella sp.	†		
Cleon dipterum	†		
Ephemera vulgata	†		
(Diptera)			
Tanypus	†	†	†
Chironomus	†	†	†
Simulium spp.	†		
Dicronata spp.	†	† (rare)	
(Coleoptera)			
Hydrobius sp.	†		
(Tricoptera)			
Limnophilus extricatus ...	†		
Stenophylax nigricornis ...	†		
Micropterna nycterobia ...	†		
Sericostoma sp.	†		
Halesus auricollis	†		
Goera sp.	†		
MOLLUSCA			
Limnaea peregra	†	†	†
Ancylus fluviatilis	†	†	†
Pisidium spp.	†	†	†

Discussion of Analytical Data

Solids in suspension. At Brownhill Reservoir there was seldom more than a trace of suspended matter. The relatively high amount present at the time of the second survey was due to the heavy rain during the preceding 24 hours, and the consequent flow of peaty water from the gathering grounds. This was also reflected in other determinations, particularly in the transparency which showed a reduction of from over 24ins. at the time of the first survey to only 6.5ins.

At Hollin Brigg Lane there was an increase in the amount of suspended matter over that at Brownhill. This was generally only slight except when much suspended matter was brought in from Digley Brook (e.g., 11th Survey).

At other points there was usually a fairly marked fluctuation. The reduction observed on occasions at Perseverance Mill was probably due to the sedimentation effect occurring at the weir above the mills.

Solids in solution. These were usually remarkably low at all points, and were often comparable with the amount found in drinking waters.

Chlorides. The amount of chloride was also very low, only a very slight increase being observed in the lower reaches.

Nitrogen. The amount of nitrogenous matter was low, and there was usually a small amount of nitrate at all points.

Oxygen absorbed from N/80 permanganate. While these values were usually of the same order as the five-days biochemical oxygen demand, there was evidently no relation between the two. This fact has, of course, been frequently observed by various investigators in the past.

Alkalinity. This was never in excess of 10 parts per 100,000 calculated as calcium carbonate to methyl orange, and was usually less than this.

Dissolved Oxygen Absorption (B.O.D.), Oxygen in solution and "Oxygen balance." These values have been dealt with fully under the respective sampling points. The percentage saturation was usually fairly high at all points, but in the lower reaches there were frequently conditions of negative oxygen balance.

Bacteriological. Rather marked variations, evidently due to seasonal and weather conditions, were found in regard to the numbers of B. coli at the several sampling points. Except on rare occasions the counts were low in the waters of the upper reaches and, although they were higher further downstream they were not sufficiently high to indicate any material pollution by domestic sewage. From this evidence it would appear safe to assume that the pollution effects recorded in the surveys were almost entirely due to trade effluents.

Biological. It seems very probable that the deposit of sludge is one of the chief factors influencing the living organisms in the stream. It is rather difficult to account for the amount of this flocculent sludge on the stream bed. It is possible that part of it is derived from the slow but continuous coagulation of a slight excess of precipitant present in the mill effluents. The amount of fibrous textile matter was also rather unexpected, since the effluents rarely contained more than the smallest traces of it. There is no doubt that occasional discharges of untreated scour liquor reached the stream. This was particularly observed at the time of the tenth survey, when the stream bed between the outfall at Bottoms Mill and the end of the goit was covered with a thick deposit of grey sludge. On the same occasion, although there was no effluent from Yew Tree Mills there was evidence of a recent overflow to the stream from the filters, which were full of sludge. Immediately after the entrance of the first mill effluent into the stream, there is complete absence of mosses and algae from the stones in the bed of the stream, and at the same time the number of animal species is greatly reduced.

The table on page 33 shows the large number of species living in the unpolluted part of the stream between Brownhill and Holmbridge. Some of these species are vegetable feeders and are attached to mosses, and would naturally disappear with the plants, but this alone does not account for the rapid drop in the number of species. It is probable that the deposit of sludge would suffocate some of the types which depend on a flow of clean water for their respiratory processes, e.g., Caddis, Mayfly and *Simulium* larvae, *Hydracarina* and *Gammarus*. Only a few species (*Nais*, *Tanypus*, snails and leeches) persist and thrive in the sludge deposit. *Nais*, leeches and snails occur in the unpolluted region, but their numbers are relatively few. The larvae and pupae of the gnat *Tanypus* were present in large numbers in both unpolluted and polluted regions throughout the year.

Accumulated sludge was observed to pass through a series of changes. With a good flow of water the sludge was usually a thick, grey, flocculent mass with a heavy growth of fungus. With low water the sludge would become exposed and partially dried, turning black and sometimes putrescent. After continued exposure, a thin film of algae, chiefly Cyanophyceae, was observed to grow on the top of this dried sludge. The table, pages 43 and 44 shows the changes in the sludge deposit which occurred during the period of observation. It is interesting to note the rise of temperature in the stream water after leaving the reservoir. This was frequently due to the warm effluents entering the stream. The growth of fungus was spasmodic, and apparently was not influenced by the temperature but rather by the condition of the sludge deposit.

Microscopic examination of the sludge showed that it consisted of many wool fibres, dyed and undyed, some cotton fibres, blue-green algae, occasional fragments of *Ulothrix* and *Spirogyra*, diatoms, nematodes, decaying leaves, sand and very fine dark grey mud.

Recovery Regions

At certain regions along the stream a partial recovery in the condition of the stream bed from the cumulative effects of pollution was observed. One of these regions occurs below the entrance of the effluent from Bottoms Mill. The stream there becomes wider and slower, before reaching a weir, and, as a result of this, the water after passing over the weir is much cleaner. On several occasions, the sludge which accumulated above the weir showed signs of putrescence when that below Perseverance Mill was definitely non-putrescent, as in July and August, 1933.

The second recovery region was at Mytholm Bridge, which is about $1\frac{3}{4}$ miles below the preceding sampling point. In this stretch the stream receives water from three tributary streams and also further relatively small volumes of normally satisfactory mill effluents. The amount of sludge at that point was frequently less than higher up the stream, but the recovery was not sufficient to cause any variation in the fauna, the species being almost the same as those collected below Perseverance Mill.

Summary

An extended quantitative chemical and biological survey of the upper portion of the River Holme, lasting over a period of sixteen months, has been made.

The unpolluted highest reach was found to support stream-life characteristic of natural clean fresh-water, but immediately below the effluent outfall from the first mill most of the usual fresh-water plant organisms and many of the animal organisms had disappeared. With the disappearance of plant organisms, the absence of those animal organisms which are vegetable feeders would naturally be expected, but another explanation must be sought in the case of other animal species. The interdependence of certain groups of organisms is well-established, so that with the elimination of a single group the ecological conditions may become widely changed. The change could not readily be attributed to any peculiar character or constituent of the trade effluent in question, which was usually satisfactory according to the standards generally accepted at the present time for the type of refuse treated. Possibly the deposition of a comparatively thin film of solid matter from the effluent might cause suffocation of those organisms which are dependent upon a good flow of clean water for their respiratory processes. This is a matter which should be further investigated with the object of acquiring more definite information. In this respect, also, it would appear that trade effluents such as those met with during the survey may exercise a greater influence on the normal biological condition of a stream than do sewage effluents of apparently similar impurity.

A good idea of the incidence of pollution may be formed by comparing the rates of stream flow shown graphically in Fig 3, page 7 with the respective volumes of trade effluents reaching the river above the individual sampling points. To facilitate this, particulars of the trade effluents from each mill are set out in the following table. In this connection, however, it must be understood that the effluents were discharged at varying rates and it is only possible to give the average rate over a normal working-day of ten hours. The volumes are expressed in gallons.

Particulars of Liquid Trade Waste

Point No.	Manufactory	Scouring—per day		Dyeing—per day		Sampled effluent	
		Thick-scour	Washing-off	Dye-water	Washing-off	Total Vol. per day	Avge. rate per hour
2	Holmbridge Mill	16,000	40,000 (u)	nil	nil	16,000	1,600
4	Yew Tree Mills	5,000	(i)	4,000	4,000 (u)	9,000	900
5	* Hinchliffe Mill	5,000	(i)	nil	nil	5,000	500
6	Bottoms Mill	25,000	50,000	30,000	(i)	105,000	10,500
10	Perseverance Mill	11,000	(i)	nil	nil	11,000	1,100
11	Valley Dyeworks	nil	nil	20,000	(i)	20,000	2,000

(u) = Clean, untreated liquid—direct to stream ; not sampled.

(i) = Volume included in figure in preceding column.

* Mill working only one day per week.

Leaving out of consideration the comparatively small volumes of clean water reaching the river from tributary streams, and bearing in mind that the trade effluents and compensation water were discharged only during the daytime, the dilutions of the former at the times of taking river samples would appear to come within the limits set out below:—

No.	Sampling point.	Total volume of trade effluents to stream per hour.	Dilution.
3	Hollin Brigg Lane ...	1,600 gallons	70 to 156
8	Below Perseverance Mill	14,600 gallons	7.5 to 17
12	Above Lower Mill ...	16,600 gallons	6.6 to 15
13	Above Mytholm Bridge	16,600 gallons	6.6 to 15

It will be seen that, during the prolonged periods of dry weather over which the survey extended, the dilution afforded in the lower reaches investigated was not large. It is therefore not surprising that the general condition of the river changed from "very clean" to "doubtful," and occasionally, "bad," in the short distance of four miles although the trade effluents were generally satisfactory as regards the standards suggested for textile wastes in the Ninth Report of the Royal Commission on Sewage Disposal (1915). At the same time it is interesting to note that in certain regions the bed of the stream appeared to show partial recovery from the cumulative effects of pollution, although this recovery was not sufficient to cause any appreciable change in the fauna.

As regards the chemical and biological results of the survey, these certainly support the following opinion expressed in an American publication some years ago, that "the study of bottom sediments furnishes a sort of summary or average of the conditions that have affected the water while the sediments were accumulating. In the study of the Illinois River, Forbes and Richardson (1913) found that the study of the bottom sludges and deposits was highly important and that the silt and other deposits accumulating on the bottom of a stream are in some respects more significant of its average condition than are the waters of its current." There can be little doubt that this statement applies with even greater truth to trade effluent pollutions than to sewage effluents.

Conclusions

From the practical standpoint of rivers pollution prevention it is obvious that the standards suggested by the Royal Commission on Sewage Disposal are not sufficiently stringent to meet the requirements of the particular case investigated, as they are based entirely on limiting amounts of suspended solids without any reference to biological purification. On the other hand, it must be admitted that the application of biological methods of purification to trade effluents alone may be both difficult and costly. The position is, therefore, much the same as that in which it was left by the Royal Commission on Sewage Disposal (Ninth Report Vol. 1, page 170), namely :—" We think it impossible to lay down, as regards each trade, such a standard as would ensure the complete purification of rivers, since, in the present state of knowledge, the attainment of such a standard would in many cases be financially impracticable and therefore useless. We have thought it useful, however, to suggests limits of impurity which we believe to be now practicable, and which are based upon careful consideration of the data given in the detailed sections."

The Commissioners suggested that such limits, if prescribed, should remain in force for a definite period, at the end of which they should be reviewed, since admittedly they were inadequate to prevent pollution of streams, and improved methods of treatment might meanwhile have been discovered.

The more one investigates the pollution of streams in districts which are the seat of manufacturing industries, the more convinced one becomes that the most effective, as well as most economical, means of protecting our rivers from damage due to the discharge of trade liquids is the treatment of these liquids, when practicable, at the sewage works of the local authority. The Royal Commission on Sewage Disposal expressed this opinion in their Third Report, and emphasised and further developed it in their Ninth Report. The present Joint Advisory Committee on River Pollution in their Second Report (1930) covered rather extensively most aspects of the question, even to illustrating by draft clauses the lines on which the necessary further legislation might well proceed. It had been hoped, with some degree of confidence, that the required legislation would have been forthcoming this year subsequent to the passage of The Public Health (Drainage of Trade Premises) Bill through the House of Lords, but pressure of

business prevented the Bill being dealt with by the House of Commons, notwithstanding that there was almost entire agreement among all parties concerned.

In spite of the above-mentioned difficulties, the West Riding Rivers Board have as part of their policy—and with much success—continually urged local sanitary authorities and manufacturers to come to agreement in regard to the reception of trade refuse into public sewers wherever possible. The results of this survey amply demonstrate the correctness and importance of adhering to this policy.

It is hoped that the information collected and summarised in this report will prove a useful contribution to the study of rivers pollution prevention problems, as it deals with a stream unpolluted at its source and unaffected by domestic sewage pollution, but receiving considerable volumes of effluents from textile industries.

Appendices

Page

1. Sludge Deposits and Stream Temperatures ... 43

2. Faunistic Analyses 46

3. Chemical Analyses 47

SLUDGE DEPOSITS AND STREAM TEMPERATURES

No. of Survey	Date	At Brownhill Temp. °C.	At Perseverance Mill				At Mytholmbridge	
			Above Weir	Temp. °C.	Below Weir		Temp. °C.	Sludge Deposit
			Sludge Deposit		Sludge Deposit			
	1933							
1	March	5.2	heavy—putrescent	8.0	light—slightly putrescent—ochrey scum		8.6	heavy—dense fungus
2	April	9.2	heavy—and fungus	17.8	heavy—and fungus		14.6	black—no fungus
3	May	9.0	light—putrescent	17.4	black putrescent slime and thin algal film		14.6	heavy—grey slightly putrescent—dense fungus
4	June	9.6	light—and fungus	19.4	heavy—slightly putrescent—little fungus		19.6	black—no fungus
5	July	10.4	heavy—putrescent	20.0	light—non-putrescent		20.0	black—putrescent—no fungus
6	August	8.9	heavy—putrescent	22.2	fairly heavy, no fungus		20.0	grey—no fungus
7	September	11.1	very heavy—putrescent	16.7	heavy after opening of mill dams—slightly putrescent		16.7	black

8	October	10.0	heavy and sandy	11.7	no sludge in mid-stream but sandy at sides	11.7	black—slightly putrescent
9	November	6.0	heavy—and fungus	8.5	fairly heavy—and fungus	9.0	black—on fungus
10	December	2.8	heavy—and fungus	8.9	fairly heavy—and fungus	8.9	black—slightly putrescent—dense fungus
	1934						
11	January	3.9	light—no fungus	5.0	light—no fungus	5.6	brown—putrescent—no fungus
12	February	4.4	heavy—putrescent	5.6	heavy—slightly putrescent and fungus	7.8	black—slightly putrescent—no fungus
13	March	14.2	light	5.0	light—no fungus	5.3	light—no fungus
14	April	7.8	heavy and sandy and fungus	10.0	heavy and sandy, slight fungus	12.2	light—blackish, no fungus
15	May	7.2	heavy—putrescent	8.6	heavy—slightly putrescent	7.8	light—blackish, slight fungus
	June	(No observations made)					
16	July	11.1	light—no fungus	21.1	light—no fungus	23.3	light—blackish, no fungus

RIVER HOLMES
FALMSTIC

Collecting Area—2

(A=Collecting Station immediately below Plowman Reservoi

1933

June 15			July 20			Aug. 10			Sept. 21		
A	B	A	B	A	B	A	B	A	B	A	B
4	3					3	1	1			
+ one large colony	one small fragment					colony	two colonies			colony	
3 (and eggs							4			3	
5	20	33	12			6	22†			700	7
+	+	+	1				4			7	
							2			2	
						2					
42		44					1				
L20		L42				1.15					1.6
						P3					
L10		L4				L6			L9		L2
L10		L3				L4	2		L5		L3
L12		L3				L6			L8		L3
L3		L2				L1			L2		

RIVER HOLME BIOLOGICAL SURVEY
FAUNISTIC ANALYSES

Collecting Area—25 cms. x 25 cms.

(A=Collecting Station immediately below Brownhill Reservoir; B=Collecting Station below bridge to Perseverance Mill).

CLASSES / Orders / (Sub-Orders) / Species	1933																		1934											
	Mar. 23		April 27		May 18		June 15		July 20		Aug. 10		Sept. 21		Oct. 19		Nov. 21		Dec. 14		Jan. 16		Feb. 20		Mar. 20		Apr. 24		May 15		June		July 10	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
HYDROZOA																																
Hydra fusca					2		4	3			5	7	4			2			3										3			4	2
PORIFERA																																
Ephydatia fluviatilis								one small fragment																							1	
POLYZOA																																
Plumatella							+	one large colony			one colony	two colonies		one colony																	one colony	one colony
PLATYHELMINTHES																																
Planaria spp.	+	+	+	2		2	+	3 (and eggs)			+	4	+	3				3											2			2	3 (and eggs)
ANNELLIDA																																
Oligochaeta																																
Nais elinguis	+	+	6	60		30	5	20	33 Y∞	12 Y∞	6	224	+	700	7	600	12 Y+	235	5	154	12	120	6	530	Y∞	268	7	243	15	1260			7	430 Y∞
Hirudinea																																
Glossosiphonia concolor		+		4		3		+	+	6 Y∞	+	5		6 Y∞		6 Y+		3		7		3		3		4		8		8		+	12
Glossosiphonia complanata	+	+		3		2	+	+		4		4		7	3	5	2	5		5		2		2		3		10		7			8
Piscicola geometra								+	+	1	+	2	+	2								2		1						5		+	5
ARTHROPODA																																
Crustacea																																
Gammarus pulex	+		7		3		+		+		2		+		3		+		+		+		3	1	+		+		2				
Daphnia sp.	+		+		+		+		+		+		+		+		+		+		+		+		+		+					
Hydracarina																																
2 spp.	+		26		28		42		44		+		+		+		+		+		+		18		+		25 (and eggs					
Insecta																																
(Plecoptera)																																
Perla bipunctata	+		L4 P1		L14		L20		L32		L13 P3		+		L6		L7		L5		L5		L14		L10		L5		L5		L20		
(Sialidae)																																
Sialis									+		+																				3		
(Ephemerotera)																																
Baetis binoculatus	+		L7		L12		L10		L4		L6		L9		L2		L6		L11		L8		L9		L7		L5		L14		L6		
(Ecdyurus)																																
Ephemerella sp.	+				L7		L10		L3		L4		L6		L3		L4		L5		L5		L10		L10		L3		+		L5		
Cleon dipterum	+		L10		L20		L12		L3		L6		L8		L3		L5		L12		L6		L13		L6		L10		L24		L8		
Ephemera vulgata	+				L2		L3		L2		L1		L2						L2				L3				L5				L2		
(Diptera)																																
Tanypus	+	+	L135 P3	L128 P3	L91 P10	L40	L130 P9	L424 P8	L1424 P19	L140 P6	L240 P14 Y∞	L60 Y∞	L33	L340 P6	L25	L280 Y∞	L55 P4 Y∞	L60 Y∞	L54 P16	L74	L13 P3	L48 P18	L160	L78 P6	L270 P5	L112 P4	L80 P10	L30	L596	L75 P20			L740 P16	L320 P10
Chironomus	+	+			+		+					3										3						+					
Simulium spp.					+		L4		L7		L5 P2		+		+		L6 P2		L7		L3		L18		L12		L4 P2		L2				
Dicranota spp.	+		L4 P3		L9 P4		L8		L13	L3	L9		L6		L7		L15		L5		L12	L1	L7	L1	L6		L6 P2	P1	P6	L3		YL14		
(Coleoptera)																																
Hydrobius sp.					3		4		2		2				+																3		
(Tricoptera)																																
Limnophilus extricatus			L1				+		+																				L1				
Stenophylax nigricornis	+		L2		P3		+		L3		L2	1	L4 P2		L1 P3				L3		P2								L2				L2
Micropterna nycterobia	+		L2		P2		L2		+		L1		L3		L1 P1		L2				P2		L3		L2		L2		L1		P2		
Sericostoma sp.					L2		L2		L3		L2		L3		L3		L2		L2		P2		+		L2		L2		L4				
Halesus auricollis					L1		+		+		L2		L4				+										+				L2		
Goera sp.	+		+		P1		L2		L2		L3		L3		P2		+		P1		P2		L3		L2		L2		L2				
MOLLUSCA																																
Limnaea peregra		+	+	10	+	12	+	14	+	12	6	12 Y∞	+	14 Y+	8	15 Y+	4	12	2	24	+	11	4	10	+	10	+	14	3	11			+	15
Ancylus fluviatilis	+	+	+	16	+	14	4	12	+	24 Y∞	7	16 Y∞	+	20 Y∞		24 Y+	13	16	5	20	3	8	+	14	+	8	+	10	7	17			10	10
Pisidium spp.					4	+	+	+	6	+	5	+	10	6	5	4	24	+	3	+	+	7	+	+	7	8	2	8	5	5			6	3

Preliminary Survey. No numerical analyses made.

No collections made.

L=Larvae. Y=Newly-hatched Forms. P=Pupae. +=Species present in stream though absent from collecting area.

FIRST SURVEY

23rd March, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Albuminoid Ammonia (Wanklyn)	Oxygen absorbed (Kubel Tiemann)	Nitrates as $CaCO_3$	Nitrites as $CaCO_3$	Dissolved Oxygen Test on Delivery
	Total	Ash	Total	Ash						
1	trace	—	9.2	6.2	1.5	0.002	0.001	0.008	0.9	0.0
1A	0.6	0.4	7.0	4.4	1.5	0.002	0.004	0.022	nether	0.0
2										
3	0.6	0.4	7.4	5.4	2.0	0.004	0.003	0.045	0.4	0.2
4	64.8	8.4	464.4	399.2	16.0	0.450	0.140	1.300	233.7	12.1
5									50.6*	
6	0.6	0.2	10.0	6.8	2.0	0.003	0.016	0.080	1.0	0.0
10	0.5	0.3	22.4	20.6	2.0	0.012	nil	0.058	1.5	0.4
8	0.6	0.4	9.8	6.8	2.0	0.038	0.015	0.047	0.8	0.2
11										
12	0.9	0.4	10.0	7.6	2.0	0.010	0.014	0.116	1.0	0.1
13	0.3	0.3	12.2	9.2	2.0	0.027	0.006	0.093	1.0	0.1

* Albuminoid Ammonia due to decomposition of organic matter (after acidification) 71.8 parts.

† Albuminoid Ammonia due to decomposition of organic matter (after acidification) 71.8 parts.

FIRST SURVEY

23rd March, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.50 a.m.	9.2	trace	—	9.2	6.2	1.5	0.002	0.001	0.008	0.04	0.09	—	0.9	0.05	1.24 at 5.2°C	100.0	over 24.0	47
1A	*Digley Brook at Holmbridge*	*12.10 p.m.*	*7.6*	*0.6*	*0.4*	*7.0*	*4.4*	*1.5*	*0.002*	*0.004*	*0.022*	*0.02*	*0.26*	*0.24*	*neutr.*	*0.04*	*1.18 at 6.2°C*	*97.5*	*16.5*	absent
2	*Effluent from Holmbridge Mill*	*(No effluent)*																		
3	River Holme at Hollin Brigg Lane	12.35 p.m.	8.0	0.6	0.4	7.4	5.4	2.0	0.004	0.003	0.045	0.03	0.22	0.18	0.4	0.28	1.16 at 6.6°C	96.7	23.0	5
4	*Effluent from Yew Tree Mills*	*1.0 p.m.*	*‡529.2*	*4.8*	*8.4*	*464.4*	*399.2*	*16.0*	*0.450*	*0.140*	*1.300*	—	*16.84*	*7.81*	*233.2† 36.8**	*11.08*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*(No effluent)*																		
6	*Effluent from Bottoms Mill*	*1.25 p.m.*	*10.6*	*0.6*	*0.2*	*10.0*	*6.8*	*2.0*	*0.003*	*0.016*	*0.080*	—	*0.41*	*0.30*	*1.0*	*0.93*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.20 p.m.*	*22.9*	*0.5*	*0.3*	*22.4*	*20.6*	*2.0*	*0.012*	*nil*	*0.058*	—	*0.22*	*0.20*	*1.5*	*0.40*	—	—	—	—
8	River Holme below Perseverance Mill	2.10 p.m.	10.4	0.6	0.4	9.8	6.8	2.0	0.038	0.015	0.047	0.01	0.23	0.19	0.8	0.21	1.12 at 8.0°C	96.6	15.0	absent
11	*Effluent from Valley Dyeworks*	*(No effluent)*																		
12	River Holme above Lower Mill	3.25 p.m.	10.9	0.9	0.4	10.0	7.6	2.0	0.010	0.014	0.116	0.04	0.41	0.31	1.0	0.68	1.06 at 8.4°C	92.2	9.0	absent
13	River Holme at Mytholm Bridge.	4.0 p.m.	12.5	0.3	0.3	12.2	9.2	2.0	0.027	0.006	0.093	0.08	0.21	0.21	1.0	0.47	1.07 at 8.6°C	93.0	14.0	480

‡ *Includes fatty matter (after acidification) 71.8 parts.*

* *Alkalinity as Na OH (to p.p.)*

† *Alkalinity as Na_2CO_3 (to m.o.)*

SECOND SURVEY

27th April, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	11.0 a.m.	11.0	2.8	1.6	8.2	4.4	2.0	0.010	0.013	0.044	0.02	0.70	0.28	neutr.	0.06	0.99 at 9.2°C	87.6	6.5	235
1A	*Digley Brook at Holmbridge*	*12.20 p.m.*	*11.6*	*0.2*	*0.1*	*11.4*	*5.8*	*2.0*	*nil*	*0.013*	*0.064*	*0.05*	*0.38*	*0.36*	*3.0*	*0.68*	*0.92 at 11.8°C*	*86.0*	*9.5*	*200*
2	*Effluent from Holmbridge Mill*	*12.5 p.m.*	*60.4*	*3.8*	*0.9*	*56.6*	*47.6*	*2.0*	*0.003*	*0.014*	*0.054*	—	*1.38*	*0.54*	*25.5*	*0.78*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.40 p.m.	14.7	3.5	1.6	11.2	7.4	1.5	0.010	0.019	0.088	0.03	0.64	0.35	1.8	0.06	0.98 at 10.8°C	89.9	5.0	absent
4	*Effluent from Yew Tree Mills*	*(No effluent)*																		
5	*Effluent from Hinchliffe Mill*	*(No effluent)*																		
6	*Effluent from Bottoms Mill*	*1.20 p.m.*	*13.4*	*1.0*	*0.1*	*12.4*	*6.6*	*2.5*	*0.003*	*0.031*	*0.101*	—	*0.39*	*0.34*	*3.8*	*0.53*	—	—	—	—
10	*Effluent from Perseverance Mill*	*1.40 p.m.*	*42.4*	*0.4*	*0.3*	*42.0*	*37.0*	*3.0*	*0.024*	*0.024*	*0.116*	—	*0.44*	*0.39*	*4.0*	*0.56*	—	—	—	—
8	River Holme below Perseverance Mill	1.45 p.m.	15.4	1.0	0.4	14.4	9.8	2.5	0.012	0.029	0.124	0.04	0.33	0.27	3.0	0.38	0.79 at 12.4°C 0.65 at 17.8°C above weir	75.2 69.1	11.0	absent
11	*Effluent from Valley Dyeworks*	*(No effluent)*																		
12	River Holme above Lower Mill	4.10 p.m.	20.0	3.8	2.4	16.2	10.2	2.5	0.030	0.044	0.270	0.04	0.60	0.37	3.5	0.87	0.75 at 15.6°C	75.8	7.5	1,100
13	River Holme at Mytholm Bridge	4.25 p.m.	22.7	1.7	0.6	21.0	15.8	3.0	0.109	0.033	0.261	0.04	0.57	0.41	6.0	1.58	0.65 at 14.6°C	64.4	6.0	1,220

THIRD SURVEY

18th May, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.50 a.m.	8.5	0.5	0.2	8.0	5.0	2.3	0.001	0.002	0.016	0.05	0.09	0.07	1.8	0.05	1.09 at 9.0°C	95.6	over 24.0	14
1A	*Digley Brook at Holmbridge*	*12.20 p.m.*	*12.2*	*0.8*	*0.6*	*11.4*	*7.4*	*2.3*	*trace*	*0.011*	*0.051*	*0.05*	*0.25*	*0.25*	*2.0*	*0.41*	*0.93 at 14.0°C*	*91.2*	*18.5*	*1,100*
2	*Effluent from Holmbridge Mill*	*12.10 p.m.*	*68.1*	*1.9*	*0.7*	*66.2*	*59.6*	*2.5*	*0.002*	*0.006*	*0.023*	—	*1.02*	*0.70*	*20.0*	*0.76*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.40 p.m.	11.0	1.0	0.1	10.0	6.6	1.8	0.001	0.006	0.051	0.03	0.28	0.21	3.0	0.59	0.98 at 13.2°C	95.1	10.5	70
4	*Effluent from Yew Tree Mills*	*(No effluent)*																		
(4)	*Discharge below Yew Tree Mills*	*12.50 p.m.*	*44.2*	*3.6*	*1.3*	*40.6*	*29.2*	—	—	—	—	—	*1.55*	*1.25*	*7.5*	—	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*(No effluent)*																		
6	*Effluent from Bottoms Mill*	*1.20 p.m.*	*11.7*	*0.5*	*0.4*	*11.2*	*7.2*	*2.0*	*0.003*	*0.014*	*0.050*	—	*0.28*	*0.18*	*2.5*	*0.55*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.15 p.m.*	*101.7*	*1.7*	*0.6*	*100.0*	*94.0*	*4.0*	*0.068*	*0.026*	*0.132*	—	*0.69*	*0.65*	*2.0*	*0.42*	—	—	—	—
8	River Holme below Perseverance Mill	2.25 p.m.	26.0	2.2	0.8	23.8	17.0	2.5	0.061	0.049	0.211	0.02	0.61	0.49	5.5	0.93	0.57 at 17.4°C 0.65 at 19.0°C above weir	60.0 71.4	5.0	12
11	*Effluent from Valley Dyeworks*	*3-30 p.m.*	*60.6*	*1.4*	*1.1*	*59.2*	*51.2*	*12.0*	*0.325*	*0.104*	*0.371*	—	*2.41*	*2.15*	*6.0*	*0.95*	—	—	—	—
12	River Holme above Lower Mill	3.40 p.m.	25.0	1.4	0.6	23.6	19.6	3.0	0.030	0.033	0.170	trace	0.53	0.42	6.0	1.48	0.62 at 17.0°C	64.6	4.5	2,700
13	River Holme at Mytholm Bridge	4.0 p.m.	20.6	1.0	0.2	19.6	15.6	3.5	0.094	0.047	0.156	trace	0.74	0.64	4.8	1.19	0.59 at 14.6°C	58.4	5.5	5,400

FOURTH SURVEY

15th June, 1933.

(Results expressed in parts per 100,000.)

Solids in Suspension and at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl	Nitrogen			Oxygen absorbed in Three Hours at 80° Permanganate
Ash	Total	Ash	Chlorides as NaCl	Free and Saline Ammonia	Albuminoid (Wanklyn)	Oxygen Consumed (Tidy)	Nitrates	Total Ther
0.1	9.2	2.0	0.002	0.002	0.032	0.04	0.12	0.1
0.6	11.2	2.3	0.006	0.002	0.072	0.02	0.45	0.4
0.9	59.6	54.2	2.3	0.006	0.008	0.038	0.54	0.4
0.3	6.4	3.8	2.0	*Nil*	0.008	0.034	0.02	0.20	0.1
1.9	280.8	276.0	39.5	1.500	0.040	0.920	2.46	2.2
0.5	11.8	7.2	2.3	0.003	0.015	0.124	0.29	0.2
1.1	20.8	15.0	2.3	0.010	0.007	0.068	0.30	0.3
0.8	14.4	9.2	2.5	0.015	0.026	0.127	0.02	0.56	0.4
0.6	52.8	40.4	8.0	0.206	0.062	0.370	1.89	1.6
0.3	15.4	10.0	2.5	0.012	0.020	0.120	nil	0.20	0.2
2.0	26.8	20.0	3.8	0.244	0.048	0.190	0.02	0.72	0.4

FOURTH SURVEY

15th June, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	12.35 p.m.	9.3	0.1	0.1	9.2	5.4	2.0	0.002	0.002	0.032	0.04	0.12	0.11	2.0	0.09	0.96 at 9.6°C	85.7	over 24.0	9
1A	*Digley Brook at Holmbridge*	*2.0 p.m.*	*12.0*	*0.8*	*0.6*	*11.2*	*6.4*	*2.3*	*0.006*	*0.002*	*0.077*	0.02	*0.45*	*0.43*	*1.8*	*0.51*	*0.69 at 18.0°C*	*73.4*	*12.5*	*525*
2	*Effluent from Holmbridge Mill*	*12.15 p.m.*	*61.5*	*1.9*	*0.9*	*59.6*	*54.2*	*2.3*	*0.006*	*0.008*	*0.038*	—	*0.54*	*0.34*	*16.0*	*0.53*	—	—	—	—
3	River Holme at Hollin Brigg Lane	2.15 p.m.	7.3	0.9	0.3	6.4	3.8	2.0	nil	0.008	0.034	0.02	0.20	0.20	2.3	0.24	0.69 at 14.0°C	67.6	over 24.0	164
4	*Effluent from Yew Tree Mills*	*11.45 a.m.*	*283.7*	*2.9*	*1.9*	*280.8*	*256.0*	*39.5*	*1.500*	*0.040*	*0.920*	—	*2.46*	*2.29*	*15.5*	*1.33*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*(No effluent)*																		
6	*Effluent from Bottoms Mill*	*11.15 a.m.*	*12.5*	*0.7*	*0.3*	*11.8*	*7.2*	*2.3*	*0.003*	*0.015*	*0.121*	—	*0.29*	*0.28*	*3.0*	*0.58*	—	—	—	—
10	*Effluent from Perseverance Mill*	*11.0 a.m.*	*21.4*	*0.6*	*0.1*	*20.8*	*15.0*	*2.3*	*0.010*	*0.007*	*0.068*	—	*0.30*	*0.30*	*3.8*	*0.33*	—	—	—	—
8	River Holme below Perseverance Mill	2.35 p.m.	16.3	1.9	0.8	14.4	9.2	2.5	0.015	0.026	0.127	0.02	0.56	0.44	4.8	0.69	0.61 at 19.4°C 0.75 at 18.4°C above weir	67.8 81.5	5.5	9
11	*Effluent from Valley Dyeworks*	*10.50 a.m.*	*54.5*	*1.7*	*0.6*	*52.8*	*40.4*	*8.0*	*0.206*	*0.062*	*0.370*	—	*1.89*	*1.69*	*7.5*	*1.25*	—	—	—	—
12	River Holme above Lower Mill	3.55 p.m.	16.6	1.2	0.3	15.4	10.0	2.5	0.012	0.004	0.108	nil	0.36	0.30	4.0	0.72	0.70 at 20.0°C	78.7	10.0	1,000
13	River Holme at Mytholm Bridge	4.30 p.m.	31.4	4.6	2.0	26.8	20.0	3.8	0.244	0.048	0.190	0.02	0.72	0.40	6.0	1.22	0.44 at 19.6°C	48.9	5.5	1,600

LIBRARY
UNIVERSITY OF ILLINOIS

FIFTH SURVEY

20th July, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.50 a.m.	9.0	trace	—	9.0	4.8	2.0	0.003	0.003	0.030	0.04	0.10	—	1.8	0.04	0.89 at 10.4°C	80.9	over 24.0	46
1A	*Digley Brook at Holmbridge*	*12.0 noon*	*7.9*	*1.1*	*0.6*	*6.8*	*3.8*	*2.0*	*0.002*	*0.014*	*0.047*	*0.01*	*0.60*	*0.29*	*neutr.*	*0.14*	*0.87 at 16.0°C*	*88.8*	*13.0*	*absent*
2	*Effluent from Holmbridge Mill*	*11.40 a.m.*	*49.6*	*trace*	—	*49.6*	*44.0*	*2.3*	*0.002*	*0.002*	*0.044*	—	*0.47*	—	*16.0*	*0.66*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.30 p.m.	9.0	1.0	0.6	8.0	4.8	1.8	0.001	nil	0.046	0.03	0.36	0.22	1.0	0.31	0.92 at 15.4°C	92.9	14.0	absent
4	*Effluent from Yew Tree Mills*	*12.50 p.m.*	*295.7*	*3.3*	*1.6*	*292.4*	*267.4*	*20.0*	*0.990*	*0.124*	*0.458*	—	*3.17*	*2.87*	*65.0*	*3.47*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*(No effluent)*																		
6	*Effluent from Bottoms Mill*	*2.40 p.m.*	*9.6*	*1.2*	*0.3*	*8.4*	*5.2*	*2.5*	*nil*	*0.022*	*0.102*	—	*0.34*	*0.22*	*1.5*	*0.43*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.25 p.m.*	*26.6*	*2.6*	*0.2*	*24.0*	*20.4*	*2.5*	*0.009*	*0.023*	*0.107*	—	*0.43*	*0.34*	*3.5*	*0.92*	—	—	—	—
8	River Holme below Perseverance Mill	2.15 p.m.	11.8	0.4	0.1	11.4	7.8	2.5	trace	0.022	0.091	0.03	0.31	0.23	2.5	0.66	0.73 at 20.0°C 0.82 at 18.4°C above weir	82.0 89.1	13.5	360
11	*Effluent from Valley Dyeworks*	*(No effluent)*																		
12	River Holme above Lower Mill	4.20 p.m.	11.8	1.4	0.3	10.4	6.6	2.5	0.002	0.010	0.100	0.04	0.30	0.25	2.0	0.67	0.80 at 18.8°C	87.9	11.5	280
13	River Holme at Mytholm Bridge	4.50 p.m.	16.4	1.4	0.7	15.0	11.4	2.5	0.168	0.033	0.180	0.02	0.45	0.36	2.8	0.83	0.63 at 20.0°C	70.8	9.5	167

SIXTH SURVEY

10th August, 1933.

(Results expressed in parts per 100,000.)

Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Nitrogen				Oxygen absorbed from N/80 Permanganate in 3 hours at 80 degrees Fahr.
Total	Ash	Total	Ash	Free Ammonia	Albuminoid Ammonia	Oxygen (Kjeldahl)	Nitrite	
—	8.6	5.0	2.0	0.002	0.001	0.037	0.03	0.08
0.5	28.0	18.2	—	—	—	—	—	4.22
0.5	13.0	10.8	2.5	0.002	0.066	0.189	—	0.72
0.2	19.0	14.6	3.0	0.021	0.022	0.051	—	0.26
1.1	31.0	25.6	4.0	0.024	0.086	0.281	—	0.96
0.5	23.0	16.8	3.5	0.204	0.056	0.280	0.01	0.57

SIXTH SURVEY

10th August, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	11.0 a.m.	8.6	trace	—	8.6	5.0	2.0	0.002	0.001	0.037	0.03	0.08	—	2.0	0.05	0.88 at 8.9°C	77.2	over 24.0	
1A	*Digley Brook at Holmbridge*	*11.55 a.m.*	*9.6*	*1.0*	*0.6*	*8.6*	*4.6*	*2.5*	*0.008*	*0.005*	*0.052*	*0.02*	*0.35*	*0.26*	*1.0*	*0.07*	*0.90 at 17.8°C*	*95.7*	*18.0*	
2	*Effluent from Holmbridge Mill*	*(No effluent)*																		
3	River Holme at Hollin Brigg Lane	12.10 p.m.	10.3	0.5	0.2	9.8	5.4	1.5	0.004	0.003	0.038	0.03	0.16	0.12	1.8	0.11	1.01 at 15.6°C	100.0	22.5	
4	*Discharge from Yew Tree Mills*	*12.30 p.m.*	*31.1*	*3.1*	*0.5*	*28.0*	*18.2*	—	—	—	—	—	*4.22*	*3.60*	*9.0*	—	—	—	—	
5	*Effluent from Hinchliffe Mill*	*(No effluent)*																		
6	*Effluent from Bottoms Mill*	*1.10 p.m.*	*17.0*	*4.0*	*0.5*	*13.0*	*10.8*	*2.5*	*0.002*	*0.066*	*0.189*	—	*0.72*	*0.34*	*5.0*	*0.83*	—	—	—	
10	*Effluent from Perseverance Mill*	*2.25 p.m.*	*19.7*	*0.7*	*0.2*	*19.0*	*14.6*	*3.0*	*0.021*	*0.022*	*0.051*	—	*0.26*	*0.24*	*2.0*	*0.26*	—	—	—	
8	River Holme below Perseverance Mill	2.15 p.m.	15.7	0.9	0.6	14.8	9.8	2.8	0.008	0.014	0.122	0.02	0.41	0.35	4.5	1.13	0.67 at 20.6°C 0.59 at 22.2°C above weir	75.7 68.6	7.0	
11	*Effluent from Valley Dyeworks*	*3.40 p.m.*	*34.0*	*3.0*	*1.1*	*31.0*	*25.6*	*4.0*	*0.024*	*0.086*	*0.281*	—	*0.96*	*0.62*	*5.5*	*0.82*	—	—	—	
12	River Holme above Lower Mill	3.50 p.m.	20.9	1.9	1.0	19.0	12.6	3.5	0.044	0.024	0.150	0.02	0.54	0.42	5.5	1.57	0.58 at 23.3°C	69.0	8.0	
13	River Holme at Mytholm Bridge	4.15 p.m.	24.5	1.5	0.5	23.0	16.8	3.5	0.204	0.056	0.280	0.01	0.57	0.51	5.8	1.36	0.44 at 20.0°C	49.4	7.5	

No determinations made.

SEVENTH SURVEY

21st September, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.45 a.m.	12.4	0.6	0.4	11.8	7.2	2.0	0.010	0.004	0.020	0.02	0.12	0.11	2.5	0.06	0.64 at 11.1°C	59.3	20.0	22
1A	*Digley Brook at Holmbridge*	*12.20 p.m.*	*14.8*	*2.2*	*1.3*	*12.6*	*6.6*	*2.3*	*0.006*	*0.019*	*0.095*	*0.02*	*0.57*	*0.47*	*3.5*	*0.36*	*0.90 at 12.8°C*	*86.1*	*8.5*	*2,100*
2	*Effluent from Holmbridge Mill*	*12.10 p.m.*	*76.6*	*4.2*	*0.5*	*72.4*	*62.4*	*2.0*	*trace*	*0.025*	*0.067*	—	*1.62*	*1.17*	*28.5*	*2.23*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.40 p.m.	16.7	4.7	1.8	12.0	8.0	2.0	0.007	0.032	0.113	trace	0.65	0.37	4.0	1.42	0.71 at 13.3°C	68.9	4.0	1,700
4	*Effluent from Yew Tree Mills*	*12.55 p.m.*	*287.8*	*15.4*	*3.7*	*272.4*	*245.2*	*25.0*	*1.665*	*0.186*	*0.611*	—	*8.30*	*6.98*	*84.0*	*3.33*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*1.20 p.m.*	*144.4*	*1.2*	*0.9*	*143.2*	*135.2*	*3.5*	*0.064*	*0.037*	*0.097*	—	*0.44*	*0.36*	*12.5*	*0.63*	—	—	—	—
6	*Effluent from Bottoms Mill*	*2.30 p.m.*	*15.0*	*1.8*	*0.1*	*13.2*	*7.4*	*2.5*	*0.001*	*0.035*	*0.106*	—	*0.35*	*0.23*	*5.0*	*0.36*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.10 p.m.*	*24.4*	*trace*	—	*24.4*	*19.8*	*3.0*	*0.055*	*0.026*	*0.094*	—	*0.34*	—	*6.8*	*0.36*	—	—	—	—
8	River Holme below Perseverance Mill	2.20 p.m.	16.8	2.4	0.8	14.4	8.8	2.3	0.006	0.041	0.134	trace	0.42	0.29	4.8	0.67	0.71 at 16.7°C 0.73 at 16.7°C above weir	74.0 76.0	7.0	8,500
11	*Effluent from Valley Dyeworks*	*3.40 p.m.*	*90.1*	*3.3*	*2.5*	*86.8*	*63.6*	*12.0*	*0.160*	*0.146*	*0.520*	—	*5.60*	*5.05*	*14.0*	*2.03*	—	—	—	—
12	River Holme above Lower Mill	3.45 p.m.	23.3	4.1	1.8	19.2	15.0	3.3	0.024	0.030	0.153	trace	0.92	0.52	6.0	0.70	0.63 at 18.9°C	69.2	5.0	9,500
13	River Holme at Mytholm Bridge	4.5 p.m.	34.8	2.6	1.2	32.2	25.4	4.3	0.358	0.052	0.286	nil	0.93	0.78	10.0	1.44	0.31 at 16.7°C	32.3	3.5	3,800

EIGHTH SURVEY

19th October, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	11.0 a.m.	10 0	trace	—	10.0	5.4	1.8	0.001	0.002	0.019	0.04	0.15	—	1.5	0.04	1.06 at 10.0°C	95.5	over 24.0	90
1A	*Digley Brook at Holmbridge*	*12.15 p.m.*	*14.6*	*trace*	—	*14.6*	*8.6*	*2.5*	*0.001*	*0.002*	*0.019*	*0.26*	*0.09*	—	*1.5*	*0.01*	*1.05 at 10.6°C*	*95.9*	*over 24.0*	*absent*
2	*Effluent from Holmbridge Mill*	*11.55 a.m.*	*58.6*	*1.4*	*0.5*	*57.2*	*52.6*	*2.0*	*0.001*	*0.009*	*0.050*	—	*1.17*	*0.85*	*20.0*	*0.75*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.40 p.m.	10.5	0.3	0.2	10.2	5.4	2.3	0.002	0.008	0.038	0.05	0.25	0.24	1.3	0.38	1.05 at 11.1°C	97.2	18.5	110
4	*Effluent from Yew Tree Mills*	*1.0 p.m.*	*311.1*	*15.5*	*2.6*	*295.6*	*273.0*	*24.0*	*0.496*	*0.105*	*0.548*	—	*6.31*	*4.39*	*96.5*	*3.84*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*1.10 p.m.*	*159.0*	*2.2*	*1.7*	*156.8*	*139.6*	*3.0*	*0.100*	*0.013*	*0.062*	—	*0.64*	*0.60*	*1.0*	*0.24*	—	—	—	—
6	*Effluent from Bottoms Mill*	*2.35 p.m.*	*12.5*	*0.5*	*0.3*	*12.0*	*7.2*	*2.3*	*0.003*	*0.022*	*0.069*	—	*0.26*	*0.22*	*2.0*	*0.31*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.20 p.m.*	*23.6*	*1.4*	*0.6*	*22.2*	*7.8*	*2.5*	*0.018*	*0.014*	*0.115*	—	*0.39*	*0.29*	*3.0*	*0.71*	—	—		—
8	River Holme below Perseverance Mill	2.15 p.m.	11.2	0.6	0.4	10.6	6.8	2.3	0.002	0.007	0.043	0.05	0.29	0.21	1.3	0.30	0.98 at 11.7°C 0.98 at 11.7°C above weir	91.6 91.6	15.0	700
11	*Effluent from Valley Dyeworks*	*3.30 p.m.*	*78.7*	*1.1*	*0.6*	*77.6*	*60.8*	*14.0*	*0.650*	*0.115*	*0.540*	—	*2.74*	*2.49*	*7.0*	*0.44*	—	—	—	—
12	River Holme above Lower Mill	3.35 p.m.	11.2	0.6	0.4	10.6	5.8	2.0	0.001	0.019	0.063	0.11	0.31	0.23	3.0	0.50	0.98 at 11.7°C	91.6	12.0	1,700
13	River Holme at Mytholm Bridge	4.0 p.m.	17.4	1.0	0.5	16.4	11.2	3.0	0.043	0.031	0.118	0.11	0.41	0.34	3.0	0.76	0.91 at 11.7°C	85.0	10.0	2,500

NINTH SURVEY

21st November, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.25 a.m.	9.3	0.5	0.4	8.8	5.8	2.0	0.005	0.005	0.023	0.06	0.11	0.10	1.5	0.07	1.14 at 6.0°C	93.4	over 24.0	8
1A	*Digley Brook at Holmbridge*	*12.10 p.m.*	*11.8*	*trace*	—	*11.8*	*7.2*	*2.5*	*0.002*	*0.020*	*0.035*	*0.26*	*0.05*	—	*0.8*	*0.14*	*1.11 at 7.0°C*	*93.3*	*over 24.0*	*0.1*
2	*Effluent from Holmbridge Mill*	*11.45 a.m.*	*51.8*	*trace*	—	*51.8*	*48.2*	*2.3*	*0.016*	*0.004*	*0.017*	—	*0.17*	—	*4.0*	*0.25*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.40 p.m.	9.2	0.6	0.3	8.6	6.4	2.0	0.012	0.006	0.017	0.05	0.17	0.15	0.8	0.08	1.11 at 7.0°C	93.3	over 24.0	4
4	*Effluent from Yew Tree Mills*	*12.50 p.m.*	*220.6*	*trace*	—	*220.6*	*203.6*	*18.0*	*0.562*	*0.111*	*0.768*	—	*2.36*	—	*9.0*	*0.56*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*1.20 p.m.*	*150.3*	*5.9*	*3.4*	*144.4*	*138.0*	*2.5*	*0.448*	*0.024*	*0.102*	—	*0.60*	*0.48*	*15.0*	*1.50*	—	—	—	—
6	*Effluent from Bottoms Mill*	*2.55 p.m.*	*12.0*	*1.0*	*0.6*	*11.0*	*7.6*	*2.3*	*0.006*	*0.018*	*0.053*	—	*0.20*	*0.14*	*1.3*	*0.44*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.30 p.m.*	*35.4*	*1.4*	*0.5*	*34.0*	*29.8*	*3.0*	*0.032*	*0.020*	*0.065*	—	*0.43*	*0.31*	*7.0*	*0.92*	—	—	—	—
8	River Holme below Perseverance Mill	2.40 p.m.	11.1	0.5	0.2	10.6	7.0	2.5	0.046	0.013	0.039	0.08	0.18	0.16	1.0	0.27	1.04 at 8.5°C 1.01 at 8.0°C above weir	90.4 87.1	18.0	107
11	*Effluent from Valley Dyeworks*	*4.0 p.m.*	*70.8*	*trace*	—	*70.8*	*55.4*	*13.8*	*0.324*	*0.092*	*0.466*	—	*5.26*	—	*6.0*	*1.56*	—	—	—	—
12	River Holme above Lower Mill	4.10 p.m.	12.7	0.3	0.2	12.4	8.4	2.8	0.012	0.013	0.048	0.07	0.28	0.24	1.5	0.32	1.04 at 8.5°C	90.4	14.5	164
13	River Holme at Mytholm Bridge	4.45 p.m.	15.0	1.0	0.2	14.0	10.4	3.0	0.069	0.022	0.064	0.12	0.34	0.24	2.0	0.71	0.98 at 9.0°C	86.0	9.0	176

TENTH SURVEY

14th December, 1933.

(Results expressed in parts per 100,000.)

TENTH SURVEY

14th December, 1933.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.45 a.m.	9.6	trace	—	9.6	6.8	2.0	0.006	0.001	0.004	0.04	0.13	—	1.3	0.04	1.23 at 2.8°C	93.2	over 24.0	4
1A	*Digley Brook at Holmbridge*		*(No flow)*																	
2	*Effluent from Holmbridge Mill*		*(No effluent)*																	
3	River Holme at Hollin Brigg Lane	12.10 p.m.	10.0	0.4	0.3	9.6	6.8	2.0	0.013	0.007	0.021	0.02	0.20	0.19	1.3	0.09	1.19 at 3.3°C	90.8	13.0	absent
4	*Effluent from Yew Tree Mills*		*(No effluent)*																	
5	*Effluent from Hinchliffe Mill*		*(No effluent)*																	
6	*Effluent from Bottoms Mill*	*12.25 p.m.*	*11.9*	*0.7*	*0.6*	*11.2*	*7.4*	*2.3*	*0.016*	*0.014*	*0.071*	—	*0.30*	*0.23*	*2.0*	*0.50*	—	—	—	—
10	*Effluent from Perseverance Mill*	*12.35 p.m.*	*12.8*	*trace*	—	*12.8*	*8.8*	*13.0*	*0.018*	*0.008*	*0.038*	—	*0.24*	—	*2.3*	*0.51*	—	—	—	—
8	River Holme below Perseverance Mill	1.50 p.m.	18.1	1.1	0.4	17.0	9.8	2.8	0.088	0.013	0.120	0.05	0.62	0.55	3.5	0.35	0.88 at 8.9°C 0.96 at 8.9°C above weir	75.4 84.2	5.5	340
11	*Effluent from Valley Dyeworks*	*3.15 p.m.*	*78.9*	*0.5*	*0.4*	*78.4*	*64.2*	*21.0*	*0.720*	*0.056*	*0.172*	—	*1.52*	*1.27*	*3.0*	*0.09*	—	—	—	—
12	River Holme above Lower Mill	3.25 p.m.	16.4	trace	—	16.4	12.0	3.0	0.051	0.014	0.046	0.04	0.33	—	3.8	0.21	0.95 at 7.8°C	81.9	10.0	absent
13	River Holme at Mytholm Bridge	4.5 p.m.	19.1	1.1	0.3	18.0	12.8	3.3	0.199	0.021	0.052	0.03	0.53	0.41	5.0	1.03	0.99 at 3.9°C	76.7	8.0	730

ELEVENTH SURVEY

16th January, 1934.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.40 a.m.	12.1	1.1	1.0	11.0	7.0	2.3	0.007	0.010	0.041	0.12	0.16	0.11	neutr.	0.07	1.21 at 3.9°C	93.8	24.0	17
1A	*Digley Brook at Holmbridge*	*11.40 a.m.*	*24.9*	*15.3*	*10.9*	*9.6*	*5.8*	*2.5*	*0.010*	*0.036*	*0.171*	*0.08*	*1.10*	*0.21*	*neutr.*	*0.19*	*1.04 at 4.4°C*	*82.2*	*4.5*	10
2	*Effluent from Holmbridge Mill*	*11.20 a.m.*	*39.2*	*trace*	—	*39.2*	*35.4*	*2.5*	*0.016*	*0.003*	*0.024*	—	*0.12*	—	*6.0*	*0.30*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.40 p.m.	22.3	5.9	4.1	16.4	10.6	2.5	0.010	0.017	0.118	0.08	0.64	0.14	0.5	0.15	1.14 at 4.4°C	90.1	8.5	28
4	*Effluent from Yew Tree Mills*	*12.20 p.m.*	*195.1*	*3.9*	*2.0*	*191.2*	*177.0*	*17.0*	*0.350*	*0.042*	*0.270*	—	*1.82*	*1.48*	*36.0*	*0.58*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*12.50 p.m.*	*127.7*	*2.7*	*1.2*	*125.0*	*117.8*	*3.5*	*0.145*	*0.022*	*0.129*	—	*0.54*	*0.35*	*8.5*	*0.88*	—	—	—	—
6	*Effluent from Bottoms Mill*	*1.10 p.m.*	*14.3*	*0.9*	*0.7*	*13.4*	*8.0*	*2.5*	*0.005*	*0.008*	*0.072*	—	*0.29*	*0.22*	*1.0*	*0.44*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.10 p.m.*	*20.6*	*0.6*	*0.2*	*20.0*	*15.2*	*2.8*	*0.030*	*nil*	*0.050*	—	*0.20*	*0.18*	*0.5*	*0.36*	—	—	—	—
8	River Holme below Perseverance Mill	1.55 p.m.	17.4	6.0	3.8	11.4	6.8	2.5	0.013	0.104	0.136	0.14	0.61	0.17	0.5	0.18	1.10 at 5.0°C 1.11 at 5.0°C above weir	88.7 89.5	8.5	20
11	*Effluent from Valley Dyeworks*	*3.10 p.m.*	*76.6*	*5.0*	*3.6*	*71.6*	*55.2*	*13.3*	*0.470*	*0.068*	*0.270*	—	*3.72*	*3.27*	*6.3*	*1.32*	—	—	—	—
12	River Holme above Lower Mill	3.20 p.m.	15.5	5.1	3.8	10.4	4.0	2.8	0.027	0.019	0.168	0.11	0.57	0.22	1.0	0.53	1.10 at 5.6°C	89.4	7.5	17
13	River Holme at Mytholm Bridge	3.45 p.m.	18.0	5.8	3.9	12.2	6.4	2.8	0.048	0.035	0.202	0.15	0.63	0.22	1.3	0.63	1.05 at 5.6°C	85.4	6.5	430

TWELFTH SURVEY

20th February, 1934.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.45 a.m.	10.2	trace	—	10.2	6.0	2.0	0.005	0.002	0.025	0.04	0.15	—	0.5	0.10	1.26 at 4.4°C	99.6	23.0	
1A	*Digley Brook at Holmbridge*	*(No flow)*																		
2	*Effluent from Holmbridge Mill*	*11.10 a.m.*	*51.9*	*1.5*	*0.7*	*50.4*	*45.0*	*2.3*	*0.001*	*0.002*	*0.034*	—	*0.38*	*0.24*	*17.5*	*0.42*	—	—	—	
3	River Holme at Hollin Brigg Lane	11.50 a.m.	10.6	0.4	0.4	10.2	6.8	2.3	0.003	0.002	0.053	0.04	0.13	0.13	0.8	0.19	1.19 at 5.6°C	96.7	over 24.0	
4	*Effluent from Yew Tree Mills*	*12.0 noon*	*313.0*	*4.6*	*3.0*	*308.4*	*290.0*	*17.5*	*3.260*	*0.028*	*0.880*	—	*1.77*	*1.37*	*23.0*	*1.31*	—	—	—	
5	*Effluent from Hinchliffe Mill*	*(No effluent)*																		
6	*Effluent from Bottoms Mill*	*12.25 p.m.*	*64.1*	*9.3*	*1.3*	*54.8*	*39.2*	*3.0*	*0.034*	*0.164*	*0.464*	—	*1.96*	*1.02*	*12.5*	*1.42*	—	—	—	
10	*Effluent from Perseverance Mill*	*1.40 p.m.*	*43.0*	*trace*	—	*43.0*	*38.8*	*3.0*	*0.046*	*0.003*	*0.059*	—	*0.29*	—	*5.5*	*0.45*	—	—	—	
8	River Holme below Perseverance Mill	1.35 p.m.	12.7	0.9	0.4	11.8	7.4	2.5	0.028	0.002	0.073	0.05	0.14	0.14	2.0	0.11	1.11 at 5.6°C 0.89 at 10.6°C above weir	90.2 81.3	12.5	
11	*Effluent from Valley Dyeworks*	*3.20 p.m.*	*78.2*	*1.0*	*0.9*	*77.2*	*61.2*	*12.0*	*0.330*	*0.080*	*0.870*	—	*4.98*	*4.74*	*8.5*	*2.20*	—	—	—	
12	River Holme above Lower Mill	3.25 p.m.	16.2	trace	—	16.2	12.2	2.5	0.022	0.007	0.148	0.08	0.29	—	3.3	0.53	0.98 at 7.8 °C	84.4	7.5	
13	River Holme at Mytholm Bridge	4.15 p.m.	18.2	trace	—	18.2	13.2	3.0	0.123	0.014	0.167	0.06	0.40	—	4.8	0.83	0.89 at 7.8°C	76.7	7.0	

No determinations made.

THIRTEENTH SURVEY

20th, March, 1914

(Results expressed in parts per 100,000.)

Solids in suspension dried at 100°C		Solids in solution dried at 100 C		Nitrogen				Cl. as NaCl	Oxygen absorbed in hours at 80° from $N/80 $KMnO_4$	
Total	Ash	Total	Ash	Albuminoid	Free NH_3	Saline NH_3	Nitrites		Total	Filtered
—	0.4	7.0	4.0	0.004	0.003	0.024	0.07	0.08	—	
—	10.2	5.6	4.5	0.014	—	0.018	0.04	0.19	—	
0.2	37.4	21.0	3.0	0.024	0.018	0.125	—	0.44	0.2	
0.6	6.6	6.0	3.0	0.007	0.010	0.056	0.05	0.21	0.1	
1.5	161.6	148.8	4.5	0.159	0.096	0.172	—	1.1	0.4	
0.4	9.2	6.4	3.0	0.010	nil	0.038	—	0.16	0.1	
—	36.6	29.6	3.0	0.025	nil	0.052	—	0.24	—	
0.6	11.4	6.8	2.8	0.016	0.008	0.023	0.12	0.15	0.1	
0.3	9.6	4.8	2.5	0.006	nil	0.034	0.08	0.19	0.1	
0.6	13.6	9.0	2.8	0.024	nil	0.131	0.14	0.24	0.2	

THIRTEENTH SURVEY

20th, March, 1934.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.45 a.m.	9.6	trace	—	9.6	7.0	2.0	0.004	0.003	0.024	0.07	0.08	—	0.8	0.09	1.21 at 4.2°C	95.3	over 24.0	1
1A	*Digley Brook at Holmbridge*	*12.5 p.m.*	*10.2*	*trace*	—	*10.2*	*5.8*	*2.5*	*0.014*	*nil*	*0.018*	*0.03*	*0.18*	—	*0.5*	*0.18*	*1.20 at 4.0°C*	*95.2*	*19.0*	*1*
2	*Effluent from Holmbridge Mill*	*11.50 a.m.*	*39.1*	*1.7*	*0.7*	*37.4*	*35.0*	*2.0*	*0.024*	*0.018*	*0.125*	—	*0.44*	*0.28*	*9.0*	*0.64*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.25 p.m.	9.5	0.9	0.6	8.6	6.0	2.0	0.007	0.010	0.056	0.05	0.21	0.14	0.5	0.24	1.17 at 4.4°C	92.9	12.5	20
4	*Effluent from Yew Tree Mills*	*(No effluent)*																		
5	*Effluent from Hinchliffe Mill*	*12.45 p.m.*	*168.9*	*7.3*	*1.7*	*161.6*	*148.8*	*4.5*	*0.050*	*0.016*	*0.173*	—	*1.21*	*0.78*	*52.0*	*2.03*	—	—	—	—
6	*Effluent from Bottoms Mill*	*1.5 p.m.*	*9.4*	*0.2*	*0.1*	*9.2*	*6.4*	*3.0*	*0.010*	*nil*	*0.038*	—	*0.16*	*0.14*	*1.0*	*0.30*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.10 p.m.*	*36.6*	*trace*	—	*36.6*	*29.6*	*3.0*	*0.025*	*nil*	*0.052*	—	*0.24*	—	*3.0*	*0.43*	—	—	—	—
8	River Holme below Perseverance Mill	2.5 p.m.	11.9	0.7	0.6	11.2	6.8	2.8	0.016	0.008	0.023	0.12	0.15	0.10	0.5	0.22	1.13 at 5.0°C	91.1	over 24.0	12
11	*Effluent from Valley Dyeworks*	*(No effluemt)*																		
12	River Holme above Lower Mill	2.55 p.m.	10.2	0.6	0.3	9.6	5.8	2.5	0.006	nil	0.084	0.08	0.19	0.17	1.0	0.40	1.12 at 5.0°C	90.3	11.5	28
13	River Holme at Mytholm Bridge	3.30 p.m.	14.4	0.8	0.6	13.6	9.6	2.8	0.024	nil	0.131	0.14	0.24	0.24	2.0	0.62	1.10 at 5.3°C	89.4	8.5	260

FOURTEENTH SURVEY

24th April, 1934.

(Results expressed in parts per 100,000.)

Solids in suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl	Free and Saline Ammonia	Albuminoid Ammonia (Fresenius & Wills)	Nitrogen as Nitrates	Oxygen absorbed in hours at 80°F from N/80 permanganate
Total	Ash	Total	Ash					
10.2	7.6	2.6	na	0.024	0.01	0.14	—	
1.1	0.3	37.2	32.8	2.5	trace	0.009	0.037	0.42
2.2	0.1	19.0	7.6	2.5	0.000	0.033	0.05	0.16
1.5	1.0	87.2	49.6	15.0	1.040	0.064	0.530	1.40
2.1	1.4	71.4	39.4	5.0	0.018	0.350	1.390	8.85
1.3	0.1	9.0	6.2	2.5	0.010	0.002	0.081	0.14
1.4	0.3	18.0	15.8	2.5	0.018	0.001	0.091	0.15
2.2	—	15.2	11.4	2.5	0.021	0.010	0.050	0.25
1.6	0.2	11.0	6.6	2.5	0.000	0.005	0.117	0.22
1.4	0.2	16.6	13.2	3.0	0.152	0.032	0.118	0.56

* *Albuminoid as NaOH* (*see p. 4*).

† *Albuminoid as* Na_2CO_3 (*see p. 4*).

LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

FOURTEENTH SURVEY

24th April, 1934.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.45 a.m.	10.2	trace	—	10.2	7.6	2.0	0.008	nil	0.034	0.04	0.14	—	1.3	0.03	1.09 at 7.8°C	94.0	over 24.0	34
1A	*Digley Brook at Holmbridge*	*(No flow)*																		
2	*Effluent from Holmbridge Mill*	*11.30 a.m.*	*38.3*	*1.1*	*0.3*	*37.2*	*32.8*	*2.5*	*trace*	*0.009*	*0.037*	—	*0.42*	*0.34*	*12.0*	*0.37*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.10 p.m.	10.2	0.2	0.1	10.0	7.6	2.3	0.005	0.004	0.033	0.05	0.16	0.14	1.3	0.28	1.02 at 10.0°C	91.9	over 24.0	21
4	*Effluent from Yew Tree Mills*	*12.20 p.m.*	*88.7*	*1.5*	*1.0*	*87.2*	*49.6*	*15.0*	*1.040*	*0.064*	*0.530*	—	*1.40*	*1.40*	*38.0*	*0.72*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*(No effluent)*																		
(6)	*Overflow at Bottoms Mill*	*12.50 p.m.*	*91.5*	*20.1*	*1.4*	*71.4*	*39.4*	*5.0*	*0.018*	*0.350*	*1.390*	—	*8.55*	*5.40*	*6.8* 30.2†*	*2.17*	—	—	—	—
6	*Effluent from Bottoms Mill*	*2.10 p.m.*	*9.3*	*0.3*	*0.1*	*9.0*	*6.2*	*2.5*	*0.010*	*0.002*	*0.081*	—	*0.14*	*0.14*	*1.5*	*0.22*	—	—	—	—
10	*Effluent from Perseverance Mill*	*1.5 p.m.*	*18.4*	*0.4*	*0.3*	*18.0*	*15.8*	*2.5*	*0.018*	*0.001*	*0.091*	—	*0.15*	*0.15*	*2.5*	*0.38*	—	—	—	—
8	River Holme below Perseverance Mill	1.15 p.m.	15.2	trace	—	15.2	11.4	2.5	0.021	0.010	0.050	0.07	0.25	—	3.5	0.05	0.86 at 11.1 C	79.6	10.5	less than1
11	*Effluent from Valley Dyeworks*	*(No effluent)*															0.93 at 10.0°C above weir	83.8		
12	River Holme above Lower Mill	3.20 p.m.	11.6	0.6	0.2	11.0	7.0	2.5	0.008	0.005	0.117	0.07	0.22	0.18	2.3	0.45	0.92 at 11.1°C	85.2	10.0	510
13	River Holme at Mytholm Bridge	3.45 p.m.	27.0	10.4	5.2	16.6	13.2	3.0	0.132	0.055	0.418	0.06	0.89	0.26	3.8	0.85	0.59 at 12.2°C	55.7	5.0	1,400

* *Alkalinity as NaOH (to p.p.).*
† *Alkalinity as Na_2CO_3 (to m.o.).*

FIFTEENTH SURVEY

15th May, 1934.

(Results expressed in parts per 100,000.)

Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C											
Total	Ash	Total	Ash										
ace	—	10.0	5.4										
	0.4	10.0	6.4										
ace	—	173.0	163.4										
	—	19.4	17.0										
ace	—	81.4	69.6										
ace	—	9.2	6.8										
ace	—	17.0	12.8										

FIFTEENTH SURVEY

15th May, 1934.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	11.10 a.m.	10.0	trace	—	10.0	5.4	2.3	0.004	0.003	0.029	0.04	0.14	—	1.3	0.09	1.04 at 7.2°C	87.4	over 24.0	2
1A	*Digley Brook at Holmbridge*	*(No flow)*																		
2	*Effluent from Holmbridge Mill*	*(No effluent)*																		
3	River Holme at Hollin Brigg Lane	12.0 noon	10.8	0.8	0.4	10.0	6.4	2.3	nil	0.007	0.049	0.03	0.19	0.16	1.0	0.14	1.08 at 7.5°C	87.3	24.0	11
4	*Effluent from Yew Tree Mills*	*12.10 p.m.*	*285.0*	*1.8*	*0.3*	*283.2*	*267.6*	*11.5*	*1.040*	*0.052*	*0.240*	—	*1.32*	*1.18*	*81.0*	*0.95*	—	—	—	—
5	*Effluent from Hinchliffe Mill*	*12.25 p.m.*	*173.0*	*trace*	—	*173.0*	*163.4*	*4.5*	*0.240*	*0.034*	*0.196*	—	*0.88*	—	*3.0*	*1.27*	—	—	—	—
(6)	*Overflow at Bottoms Mill*	*12.40 p.m.*	*77.5*	*8.1*	*0.9*	*69.4*	*42.0*	*2.5*	*trace*	*0.230*	*0.920*	—	*3.53*	*2.34*	*34.0*	*2.23*	—	—	—	—
6	*Effluent from Bottoms Mill*	*12.45 p.m.*	*11.0*	*trace*	—	*11.0*	*7.4*	*2.0*	*0.001*	*0.002*	*0.056*	—	*0.14*	—	*1.5*	*0.21*	—	—	—	—
10	*Effluent from Perseverance Mill*	*1.40 p.m.*	*19.4*	*trace*	—	*19.4*	*17.0*	*2.5*	*0.008*	*0.013*	*0.065*	—	*0.16*	—	*2.0*	*0.33*	—	—	—	—
8	River Holme below Perseverance Mill	1.30 p.m.	16.7	0.5	0.3	16.2	11.6	3.0	0.020	0.017	0.067	0.06	0.35	0.30	4.0	0.77+	0.75 at 8.6°C 0.96 at 7.8°C above weir	65.2 82.1	8.5	370
11	*Effluent from Valley Dyeworks*	*3.0 p.m.*	*81.4*	*trace*	—	*81.4*	*69.6*	*17.0*	*0.408*	*0.100*	*0.502*	—	*3.18*	—	*8.0*	*1.72*	—	—		—
12	River Holme above Lower Mill	3.5 p.m.	9.2	trace	—	9.2	6.8	2.5	nil	0.008	0.089	0.06	0.19	—	1.8	0.34	0.98 at 7.8°C	83.8	15.5	310
13	River Holme at Mytholm Bridge	3.50 p.m.	17.0	trace	—	17.0	12.8	3.3	0.076	0.005	0.129	0.04	0.49	—	3.8	0.73	0.79 at 7.8°C	67.5	7.0	1,130

SIXTEENTH SURVEY

10th July, 1934.

(Results expressed in parts per 100,000.)

Solids in Suspension dried at 100° C		Solids in Solution dried at 100° C		Chlorine as NaCl	Nitrogen			Oxygen absorbed in 3 hours at 80° from N/80 permanganate	
Total	Ash	Total	Ash		Albuminoid (Wanklyn)	Free and Saline Ammonia	Nitrite	Total	Residue
9.2	—	5.6	2.0	0.003	0.005	0.017	0.04	0.09	—
0.6	0.6	54.6	44.8	2.5	0.013	trace	0.081	1.32	0.8
0.1	0.1	9.2	5.6	2.0	trace	0.007	0.034	0.02	0.17
—	—	167.0	159.4	4.0	0.186	0.040	0.096	0.62	—
0.4	0.4	10.4	6.0	3.0	nil	0.026	0.091	0.28	0.3
0.2	0.2	19.0	14.0	3.0	0.004	0.011	0.083	0.31	0.3
0.2	0.2	20.8	14.2	2.5	0.003	0.028	0.090	0.02	0.27
					0.74 at 21.1°C				84.1
					above weir				
—	—	64.8	52.8	8.0	0.338	0.280	0.592	2.98	—
0.9	0.8	12.4	7.0	1.3	nil	0.022	0.137	trace	0.34
2.2	2.2	21.2	15.0	3.5	0.116	0.074	0.245	trace	0.65

SIXTEENTH SURVEY

10th July, 1934.

(Results expressed in parts per 100,000.)

Reference Number of Sampling Point.	Sample of	Time	Total Solids	Solids in Suspension dried at 100°C		Solids in Solution dried at 100°C		Chlorides as NaCl.	Nitrogen				Oxygen absorbed in 4 hours at 80°F. from N/80 permanganate		Alkalinity as $CaCO_3$.	Dissolved Oxygen absorbed in 5 days at 65°F.	Oxygen in Solution at time of sampling	Oxygen saturation per cent	Transparency (in inches).	Presumptive B. coli per c.c.
				Total	Ash	Total	Ash		Free and Saline Ammonia	Albuminoid (Wanklyn)	Organic (Kjeldahl)	Nitric	Total	Filtrate						
1	River Holme below Brownhill Reservoir	10.50 a.m.	9.2	trace	—	9.2	5.6	2.0	0.003	0.005	0.017	0.04	0.09	—	1.5	0.05	0.94 at 11.1°C	87.0	over 24.0	5
1A	*Digley Brook at Holmbridge*	*(No flow)*																		
2	*Effluent from Holmbridge Mill*	*11.50 a.m.*	*58.2*	*3.6*	*0.6*	*54.6*	*44.8*	*2.5*	*trace*	*0.013*	*0.081*	—	*1.32*	*0.94*	*25.0*	*0.87*	—	—	—	—
3	River Holme at Hollin Brigg Lane	12.40 a.m.	9.7	0.5	0.1	9.2	5.6	2.0	trace	0.007	0.034	0.02	0.17	0.13	2.0	0.24	0.89 at 16.7°C	92.7	18.5	90
4	*Effluent from Yew Tree Mills*	*(No effluent)*																		
5	*Effluent from Hinchliffe Mill*	*12.50 a.m.*	*167.0*	*trace*	—	*167.0*	*159.4*	*4.0*	*0.186*	*0.040*	*0.096*	—	*0.62*	—	*1.0*	*0.33*	—	—	—	—
6	*Effluent from Bottoms Mill*	*1.20 p.m.*	*10.8*	*0.4*	*0.4*	*10.4*	*6.0*	*3.0*	*nil*	*0.026*	*0.091*	—	*0.28*	*0.27*	*2.0*	*0.57*	—	—	—	—
10	*Effluent from Perseverance Mill*	*2.25 p.m.*	*19.2*	*0.2*	*0.2*	*19.0*	*14.0*	*3.0*	*0.004*	*0.011*	*0.083*	—	*0.31*	*0.26*	*4.0*	*0.38*	—	—	—	—
8	River Holme below Perseverance Mill	2.15 p.m.	21.8	1.0	0.2	20.8	14.2	2.5	0.003	0.028	0.090	0.02	0.27	0.20	3.0	0.39	0.69 at 21.1°C 0.74 at 21.1°C above weir	78.4 84.1	17.0	17
11	*Effluent from Valley Dyeworks*	*3.35 p.m.*	*64.8*	*trace*	—	*64.8*	*52.8*	*8.0*	*0.338*	*0.280*	*0.592*	—	*2.98*	—	*10.0*	*1.11*	—	—	—	—
12	River Holme above Lower Mill	3.40 p.m.	13.3	0.9	0.8	12.4	7.0	1.3	nil	0.022	0.137	trace	0.34	0.28	2.3	0.57	0.63 at 21.1°C	71.6	11.0	300
13	River Holme at Mytholm Bridge	4.15 p.m.	26.4	5.2	2.2	21.2	15.0	3.5	0.116	0.074	0.245	trace	0.65	0.45	6.3	1.15	0.44 at 23.3°C	52.4	6.0	2,100

UNIVERSITY OF ILLINOIS-URBANA
3 0112 108148252